US012179070B2

(12) United States Patent
Greaney et al.

(10) **Patent No.: US 12,179,070 B2**
(45) **Date of Patent: *Dec. 31, 2024**

(54) **GOLF CLUB**

(71) Applicant: **Taylor Made Golf Company, Inc.**, Carlsbad, CA (US)

(72) Inventors: **Mark Vincent Greaney**, Vista, CA (US); **Andrew Kickertz**, San Diego, CA (US); **Todd P. Beach**, Encinitas, CA (US); **Craig Richard Slyfield**, San Diego, CA (US)

(73) Assignee: **Taylor Made Golf Compnay, Inc.**, Carlsbad, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 298 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **17/734,185**

(22) Filed: **May 2, 2022**

(65) **Prior Publication Data**

US 2023/0119368 A1 Apr. 20, 2023

Related U.S. Application Data

(63) Continuation of application No. 17/695,194, filed on Mar. 15, 2022, which is a continuation of application (Continued)

(51) **Int. Cl.**

A63B 53/04	(2015.01)
A63B 60/42	(2015.01)
A63B 71/06	(2006.01)

(52) **U.S. Cl.**
CPC ***A63B 53/0466*** (2013.01); ***A63B 71/0619*** (2013.01); *A63B 53/0437* (2020.08); *A63B 53/0441* (2020.08); *A63B 60/42* (2015.10)

(58) **Field of Classification Search**
CPC . A63B 53/0466; A63B 71/0619; A63B 60/42; A63B 53/0437; A63B 53/0441
(Continued)

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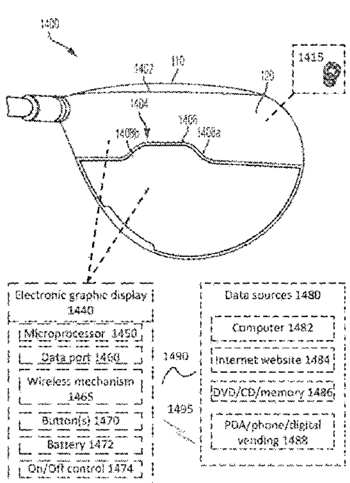
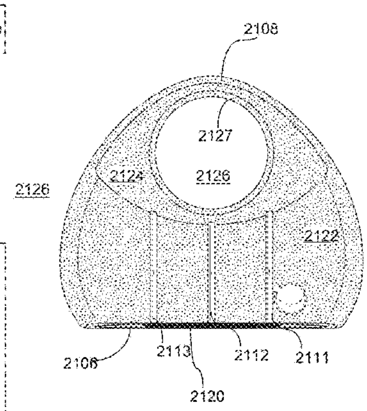
(74) *Attorney, Agent, or Firm* — Dawsey Co., LPA; David J. Dawsey

(57) **ABSTRACT**

A putter head having an upward-facing surface portion and a diffusely reflecting area of at least 5% of a total upward-facing area, which is also has a low gloss value and preferential CIELab L* value, an alignment feature delineating a transition between a first portion of the upward-facing surface having an area of contrasting shade or color with a shade or color of a portion of the face adjacent the upward-facing surface, and a face with at least a portion adjacent the upward-facing surface having a diffusely reflecting face surface area with a low gloss value and preferential chroma value. The alignment feature may have a preferential contrasting color difference between the first portion of the upward-facing surface and a portion of the face, and preferential CIELab ΔL difference value between a portion of the face and the diffusely reflecting surface of the upward-facing surface.

24 Claims, 40 Drawing Sheets
(15 of 40 Drawing Sheet(s) Filed in Color)





Related U.S. Application Data

No. 16/352,537, filed on Mar. 13, 2019, now Pat. No. 11,964,191, which is a continuation of application No. 16/046,106, filed on Jul. 26, 2018, now abandoned, which is a continuation of application No. 15/197,551, filed on Jun. 29, 2016, now Pat. No. 10,052,530.

(60) Provisional application No. 62/185,882, filed on Jun. 29, 2015.

(58) **Field of Classification Search**
USPC 473/324–350, 287–292
See application file for complete search history.

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11,219,803	B2 *	1/2022	Greaney	A63B 53/0433	
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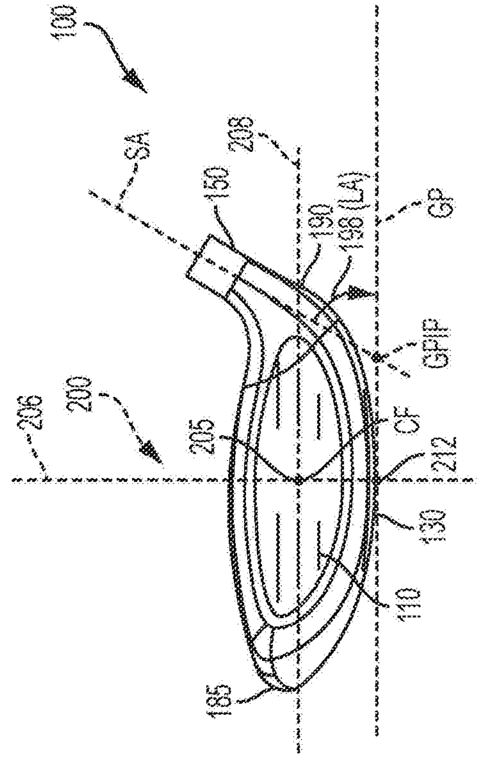


FIG. 1B

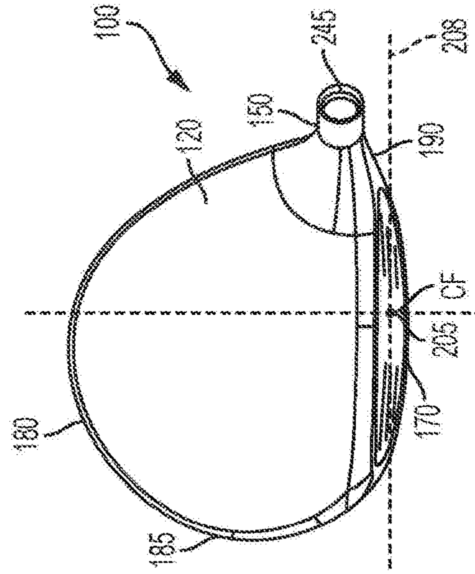


FIG. 1D

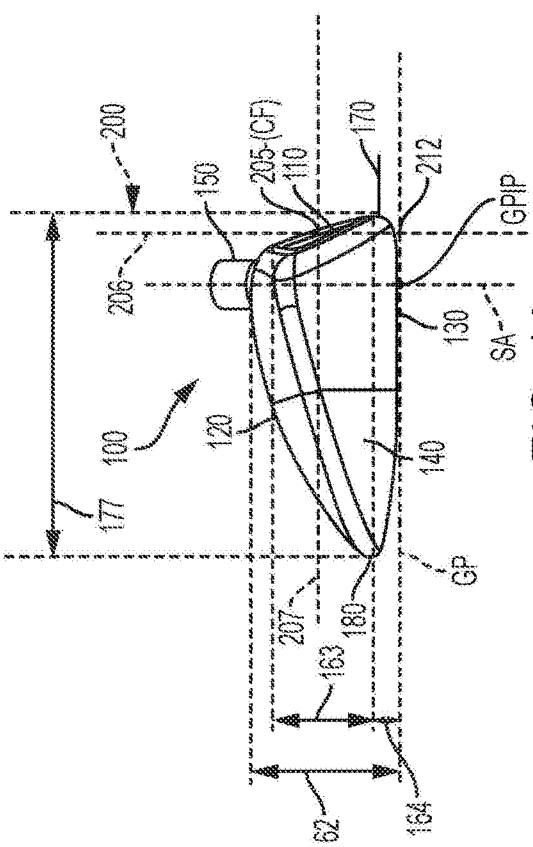


FIG. 1A

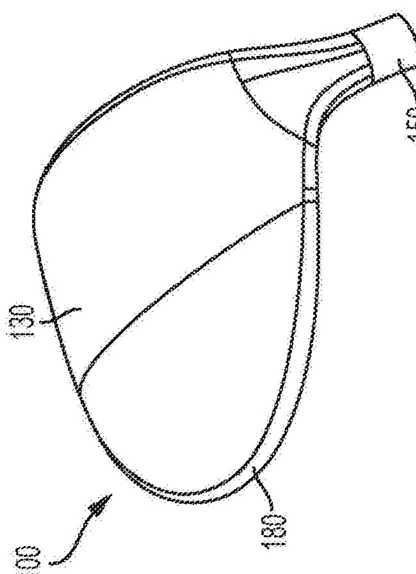


FIG. 1C

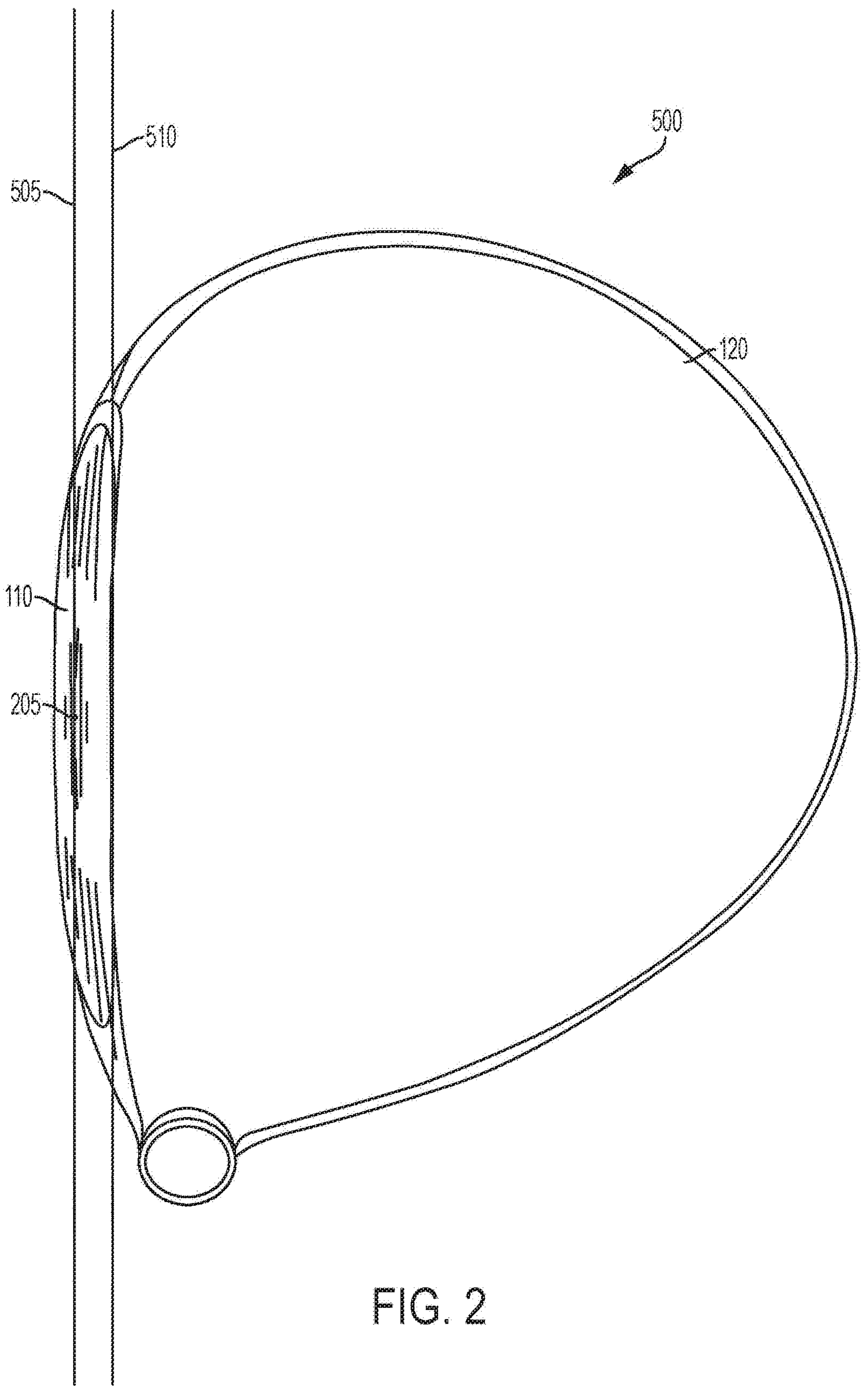
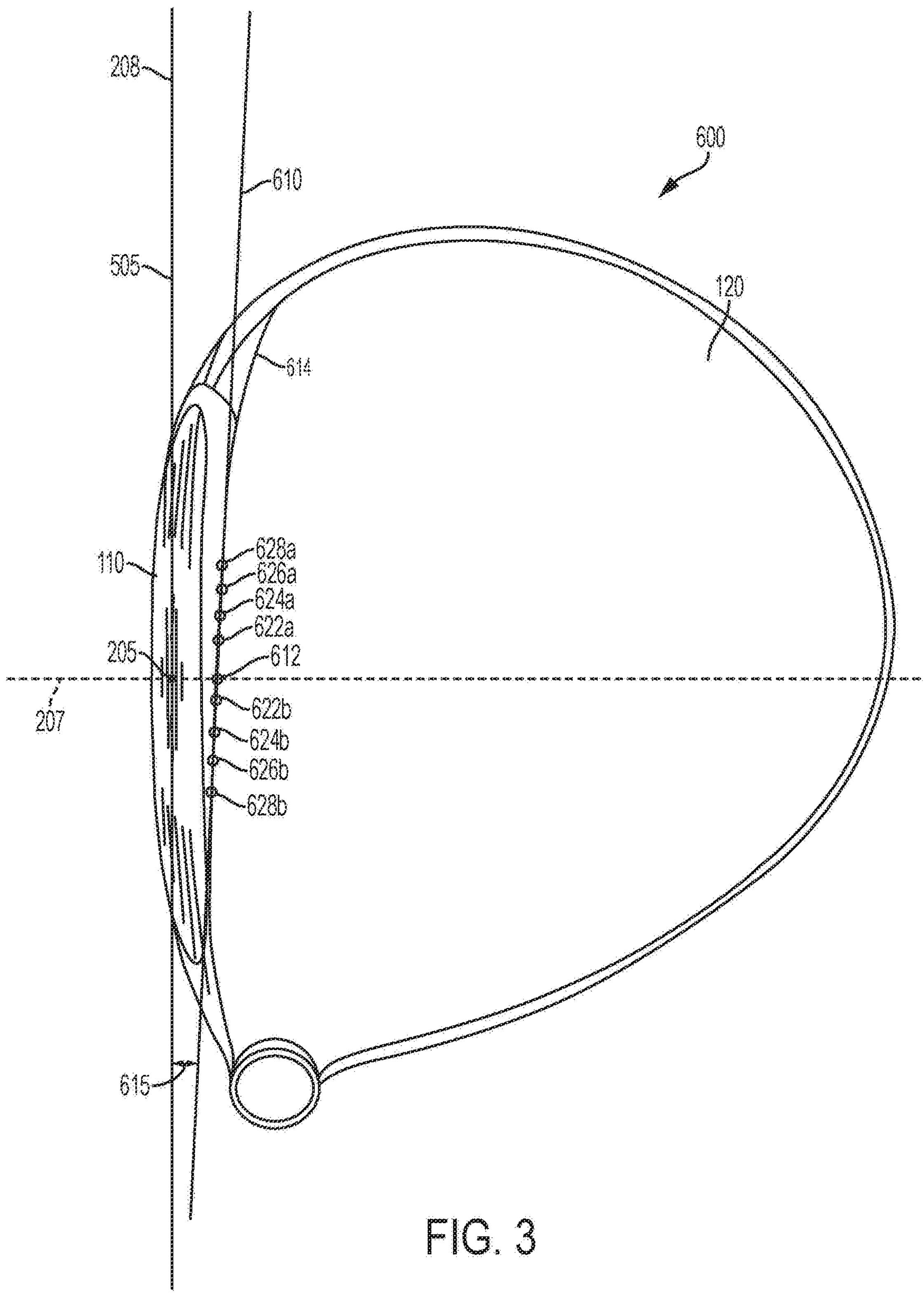


FIG. 2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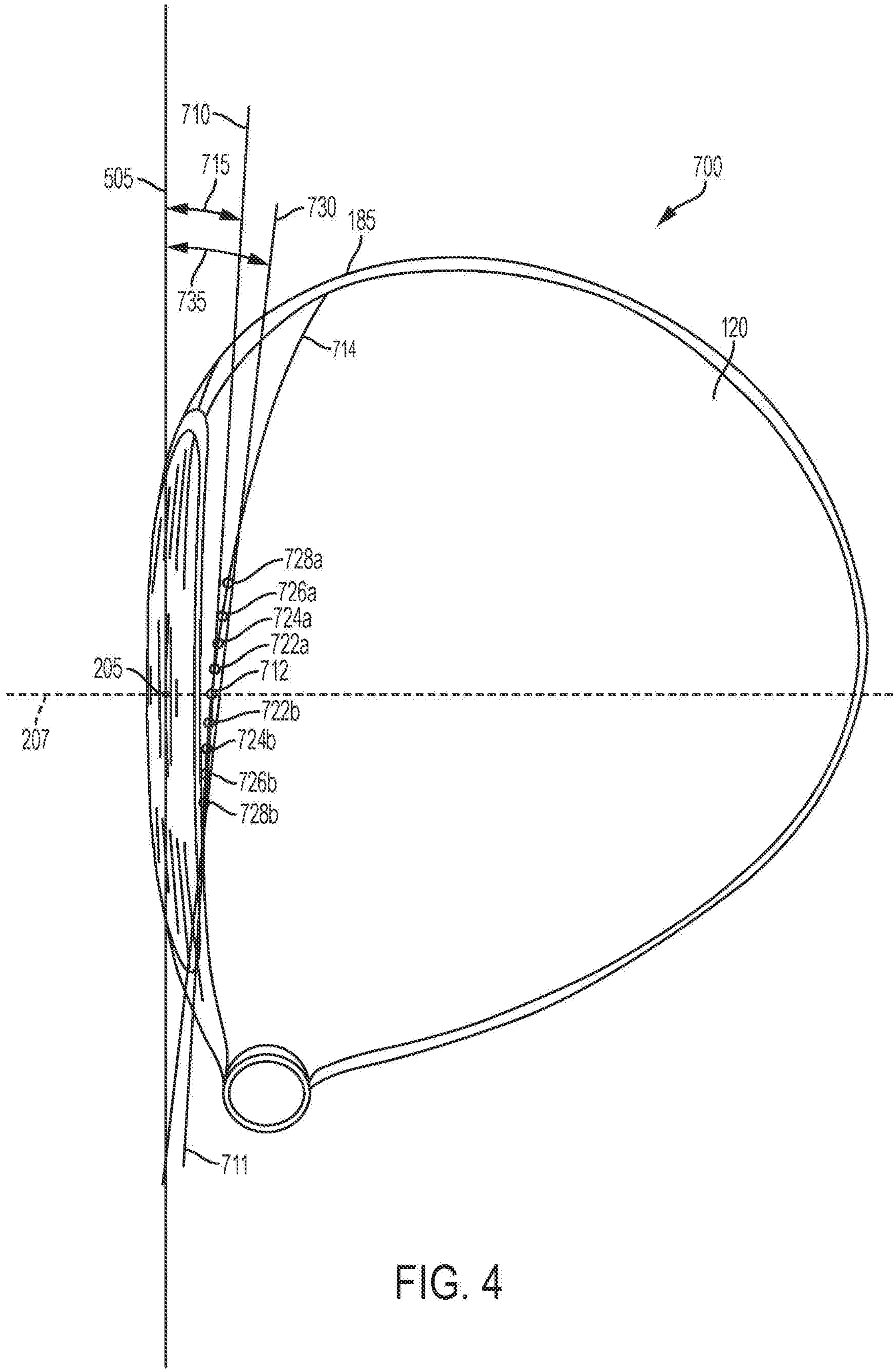
505
610
600
120
614
628a
626a
624a
622a
110
205
612
207
622b
624b
626b
628b
615

FIG. 3


710
715
505
730
185
700
735
714
120
728a
726a
724a
722a
205
712
722b
207
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726b
728b
711

FIG. 4

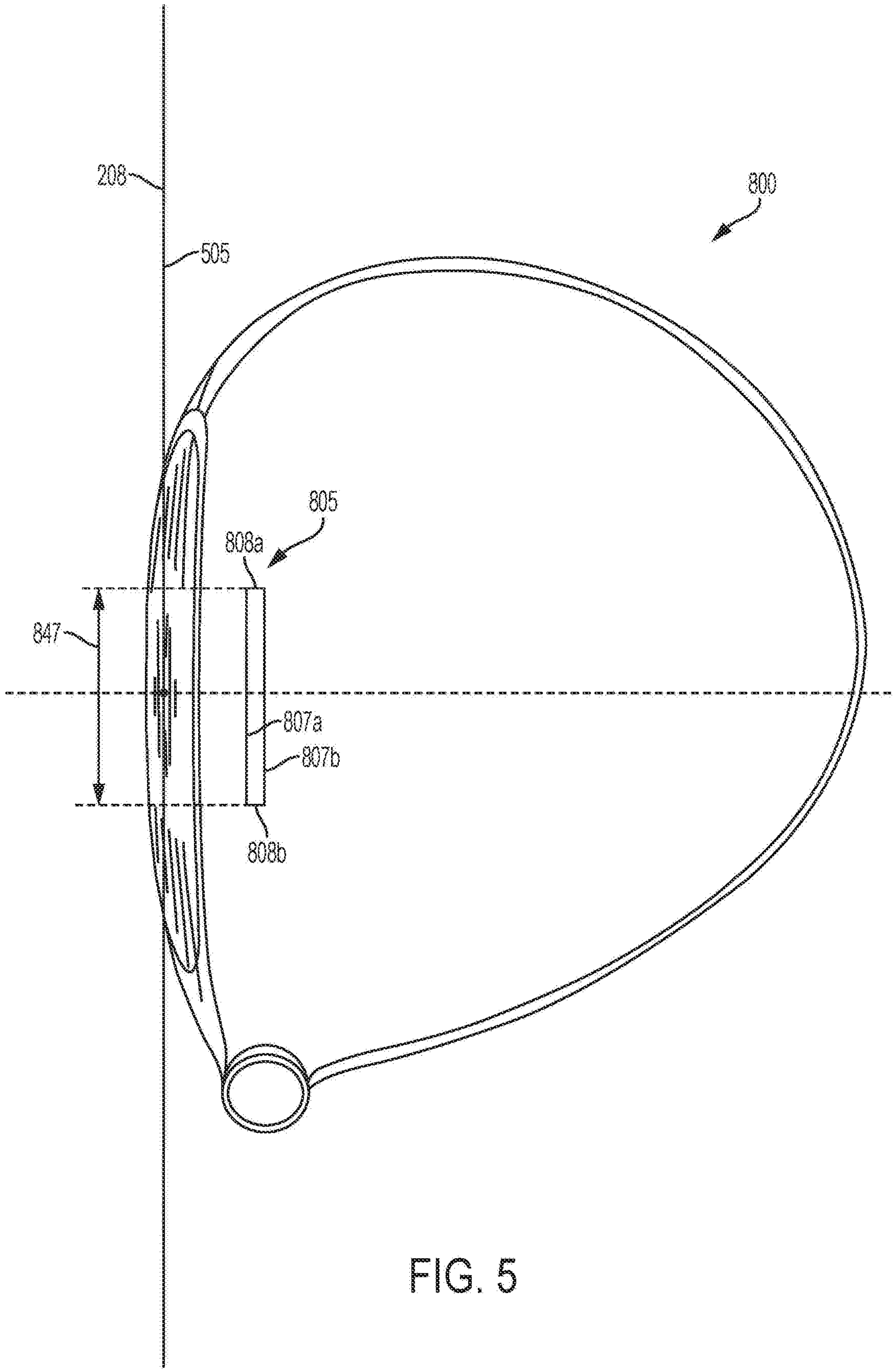


FIG. 5

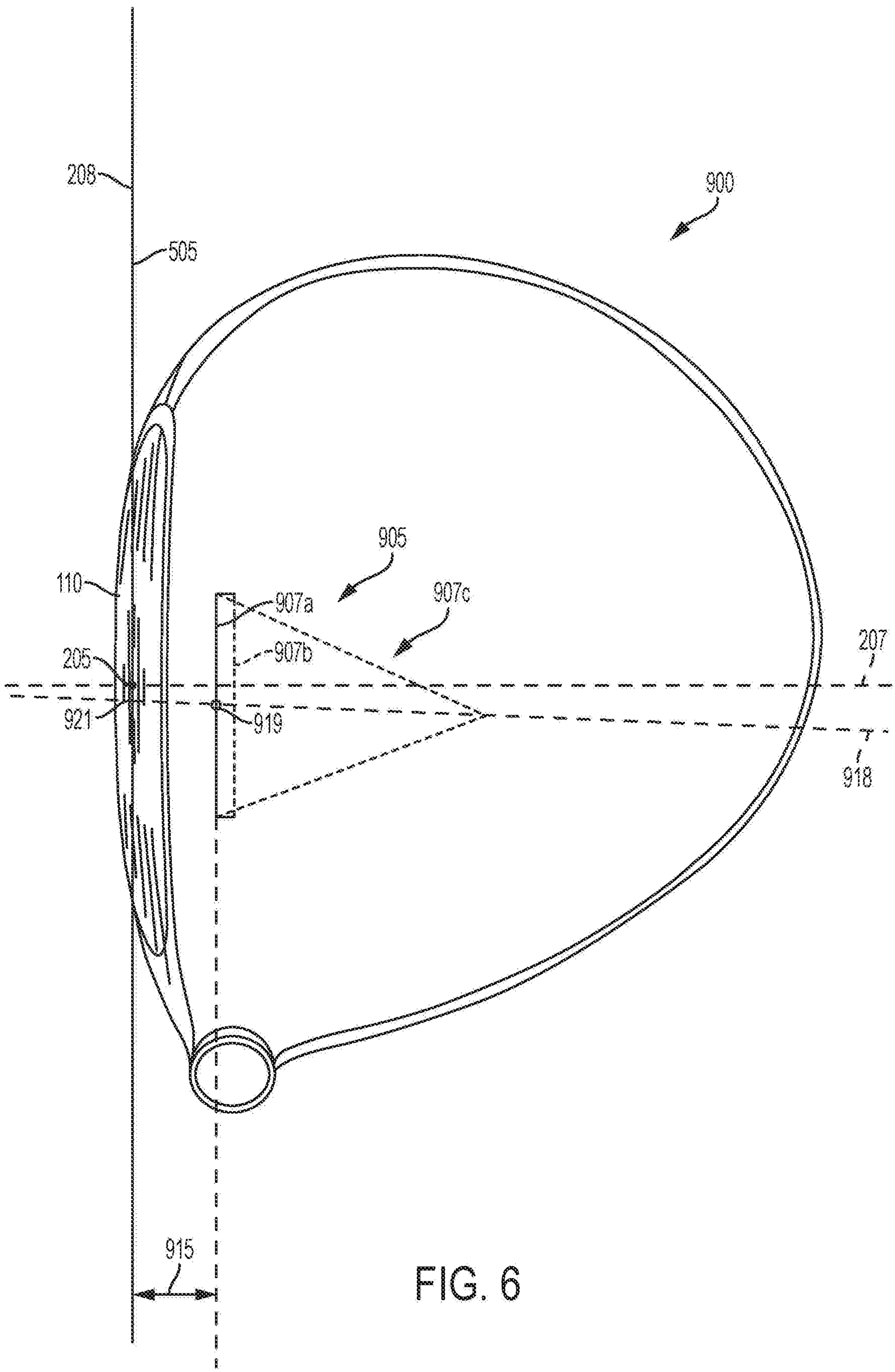


FIG. 6

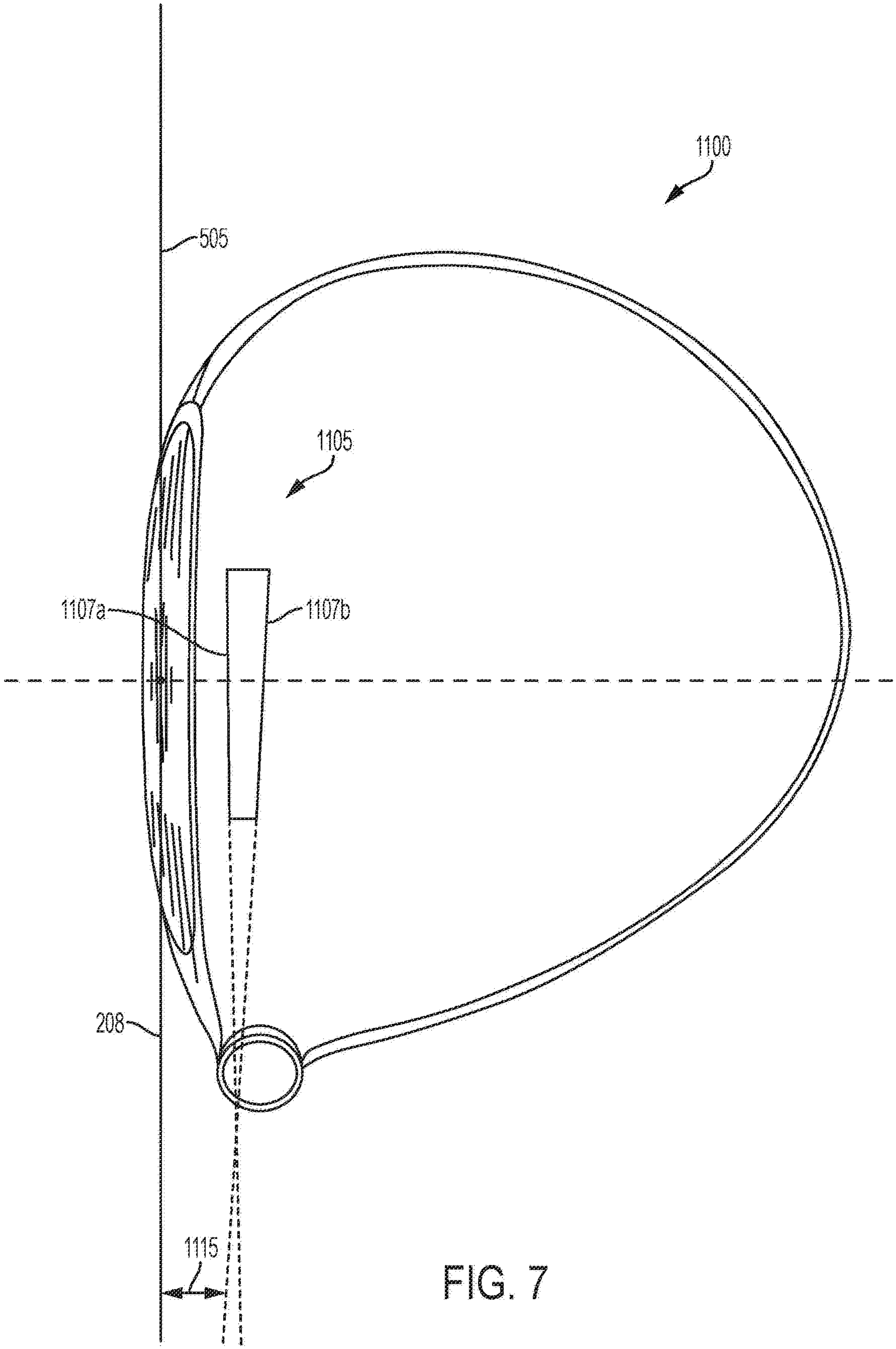


FIG. 7

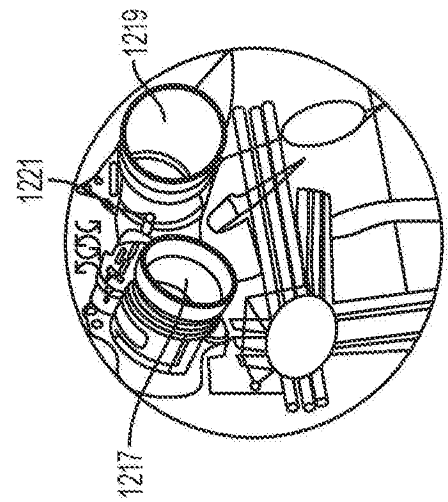


FIG. 8B

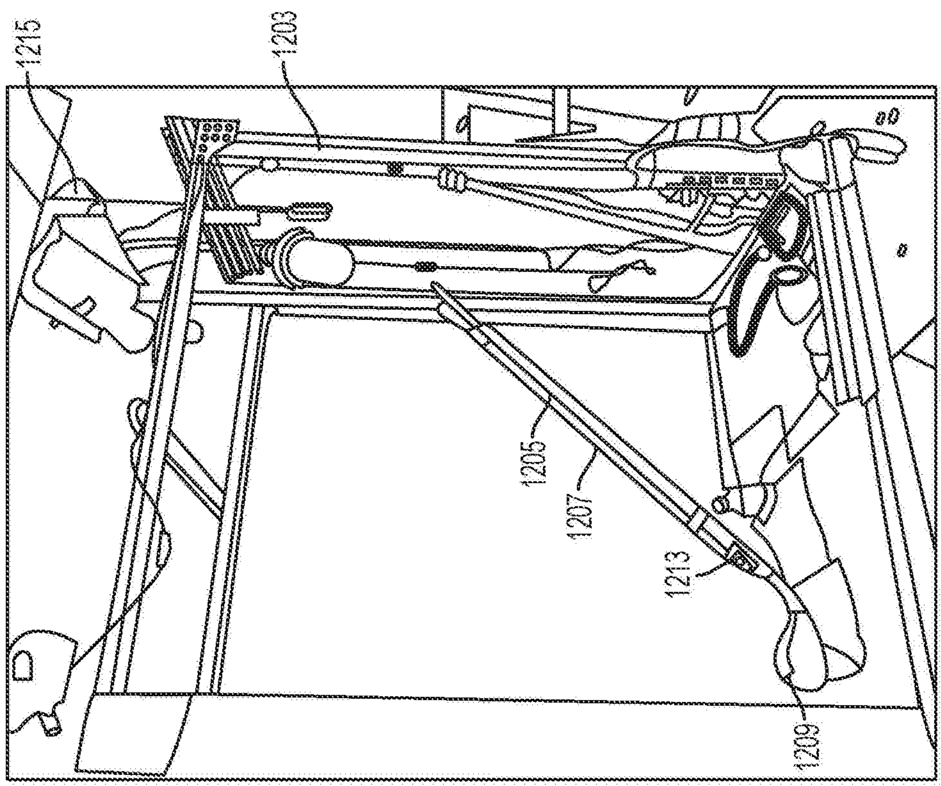


FIG. 8A

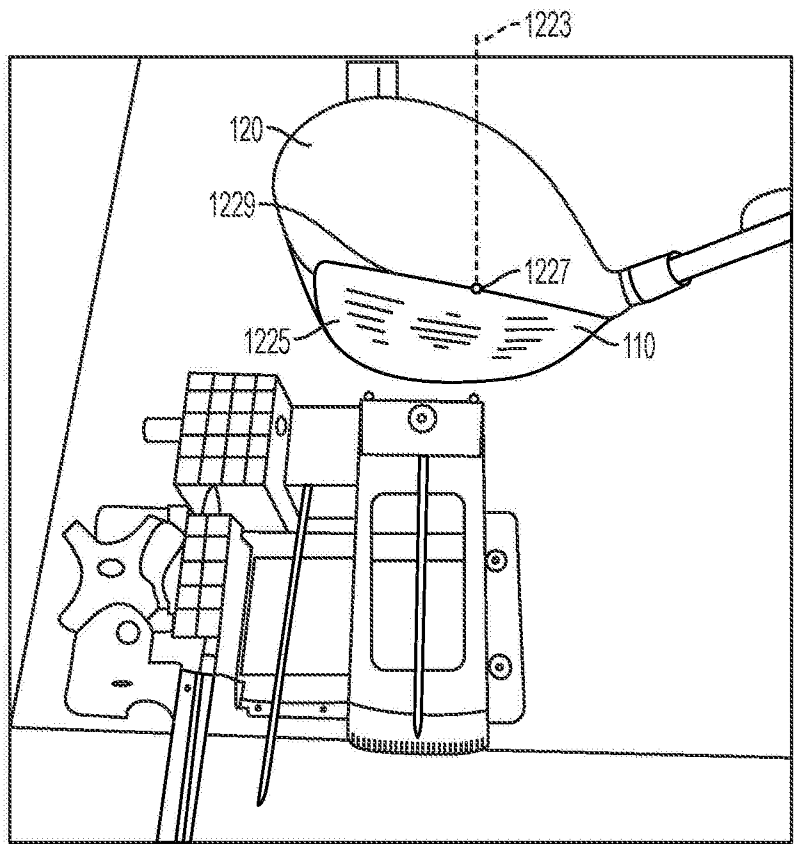


FIG. 8C

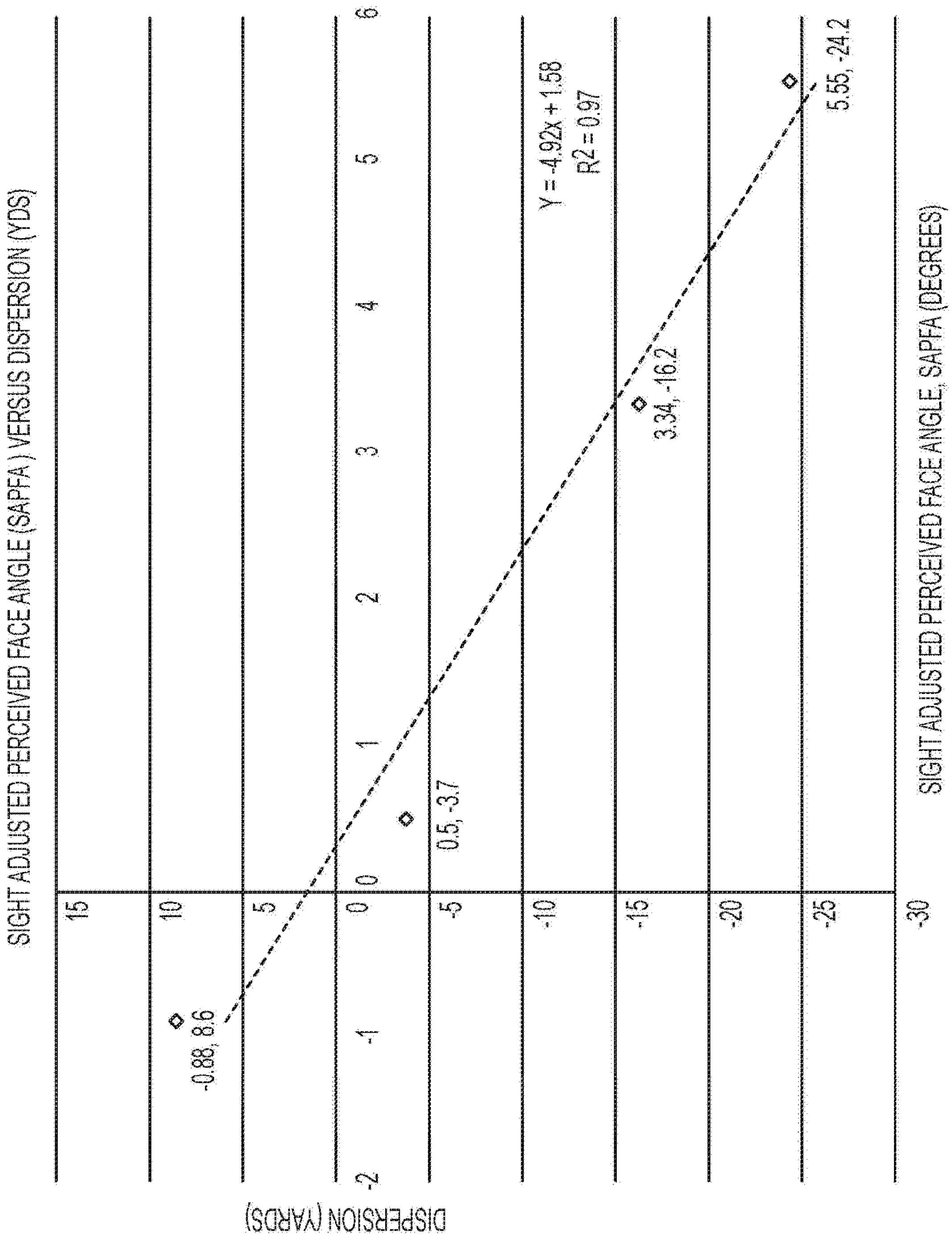

SIGHT ADJUSTED PERCEIVED FACE ANGLE (SAPFA) VERSUS DISPERSION (YDS)
DISPERSION (YARDS)
SIGHT ADJUSTED PERCEIVED FACE ANGLE, SAPFA (DEGREES)
Y = -4.92x + 1.58
R2 = 0.97
-0.88, 8.6
0.5, -3.7
3.34, -16.2
5.55, -24.2
15
10
5
0
-5
-10
-15
-20
-25
-30
-2
-1
0
1
2
3
4
5
6

FIG. 9

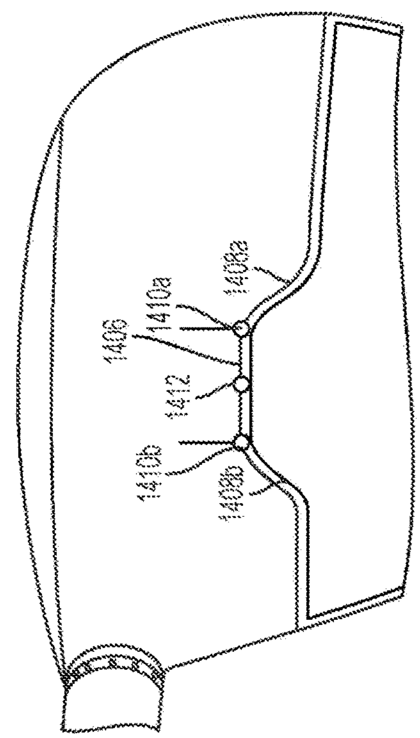


FIG. 10B

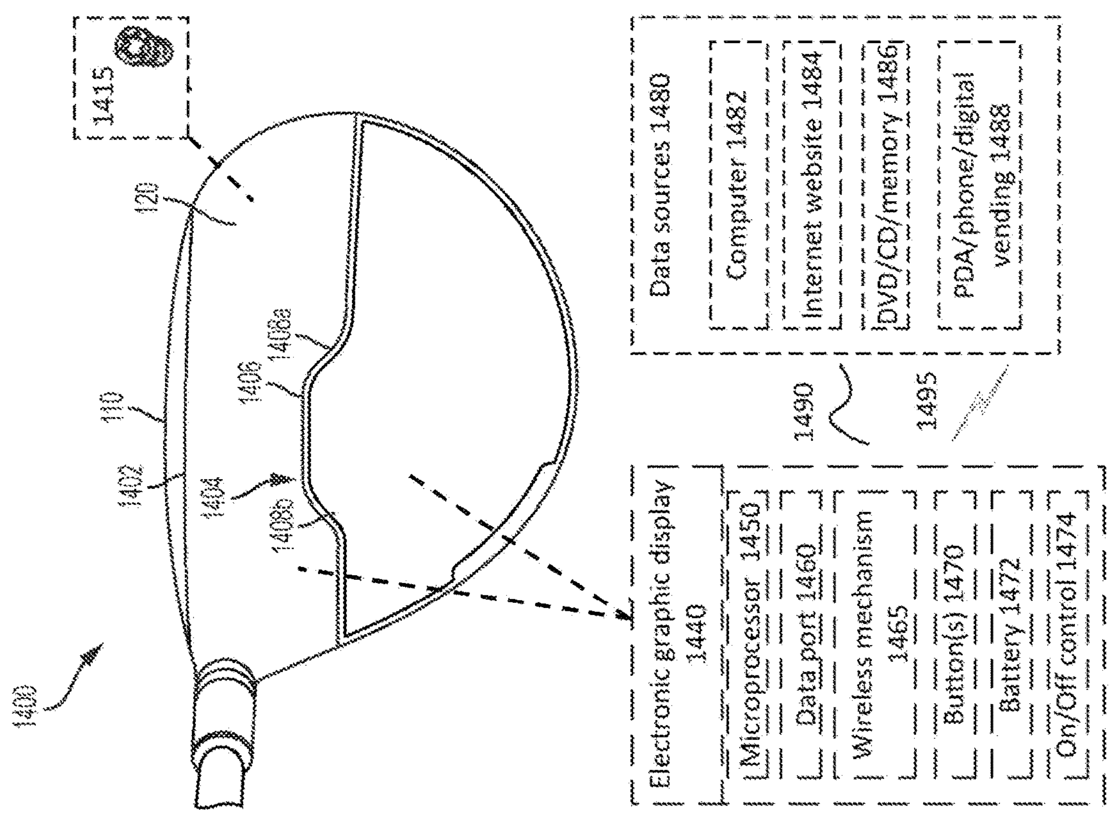


FIG. 10A

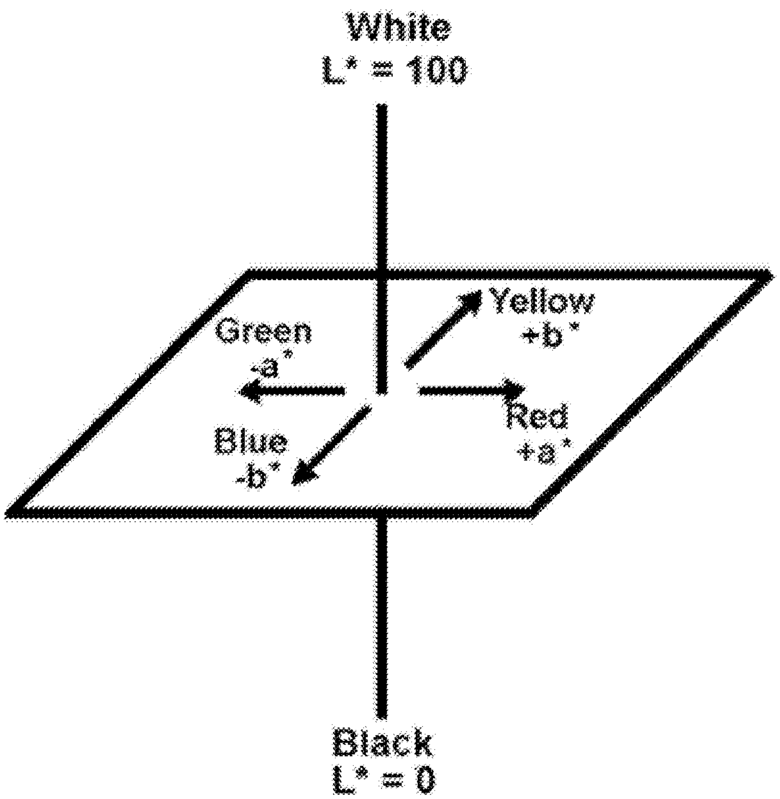


FIG. 11

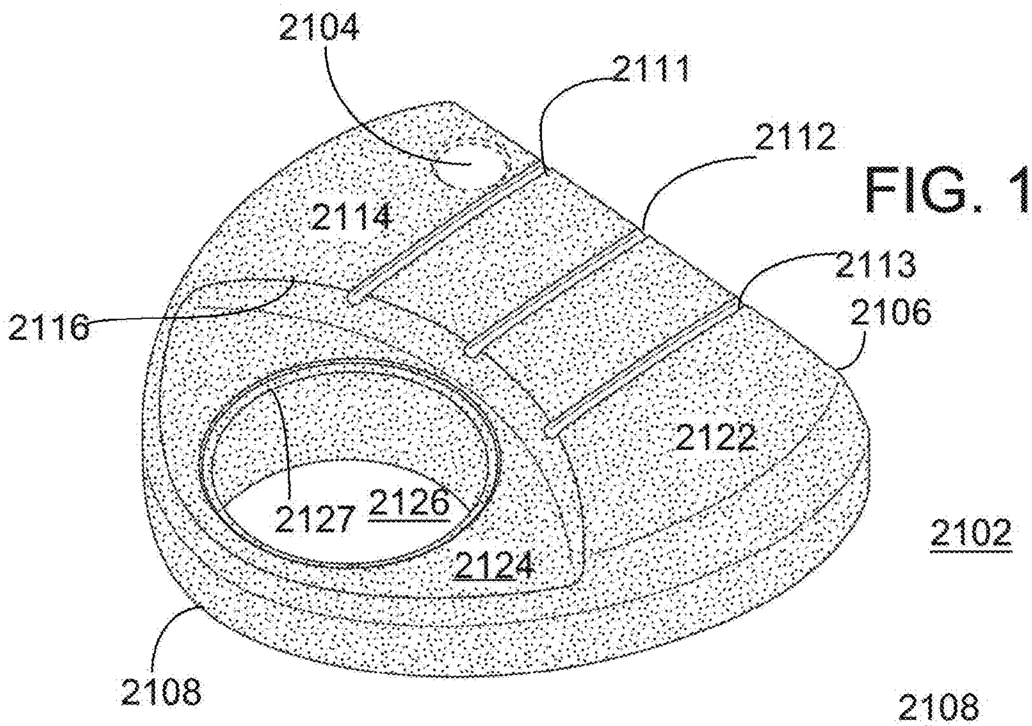


FIG. 12A

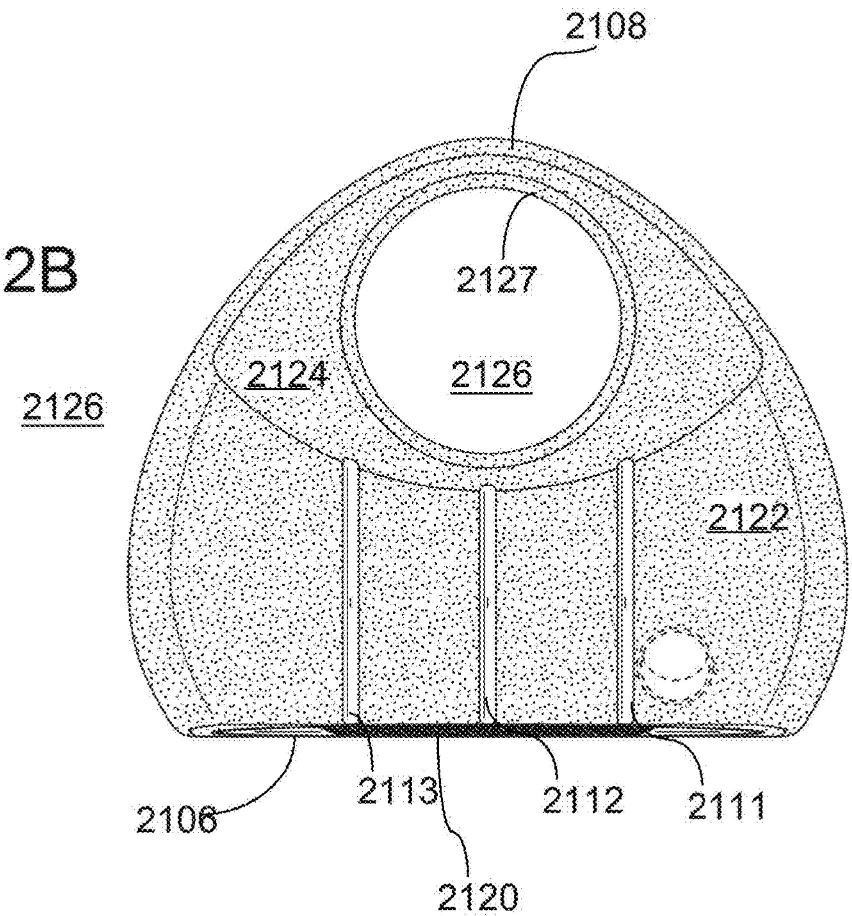


FIG. 12B

FIG. 12C

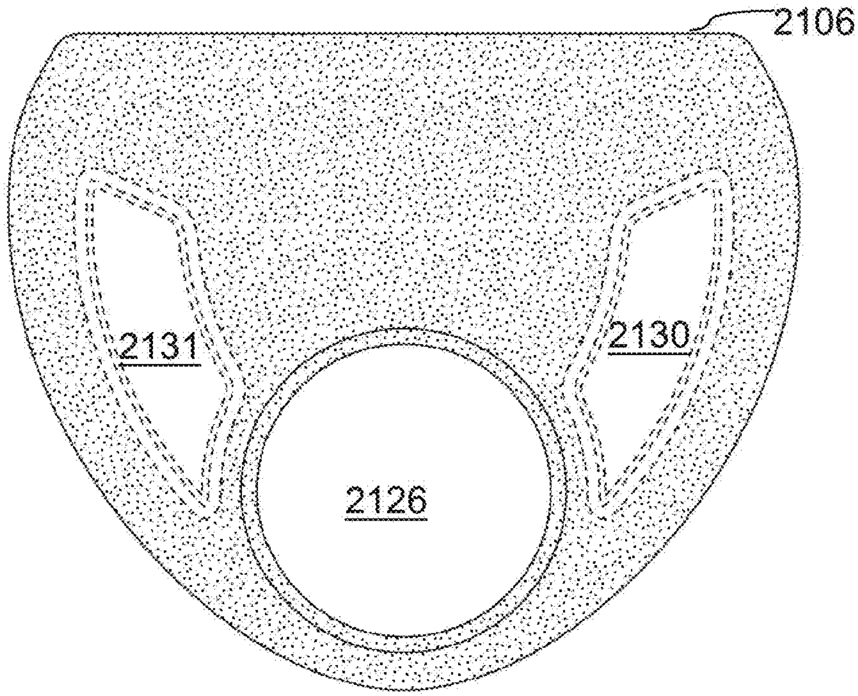


FIG. 12D

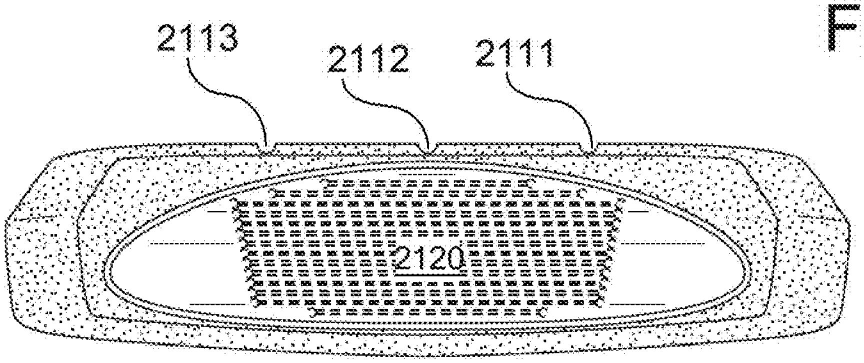
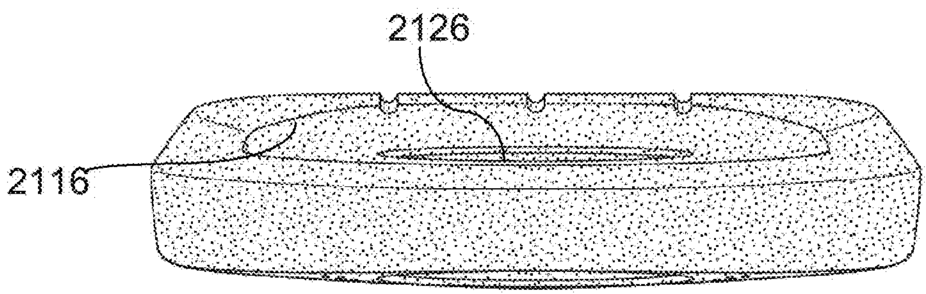


FIG. 12E



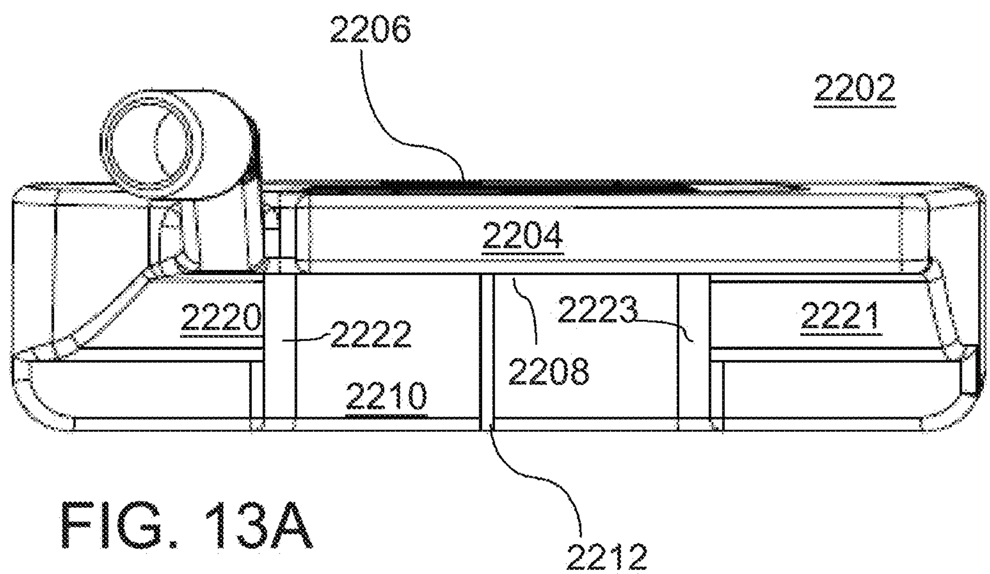


FIG. 13A

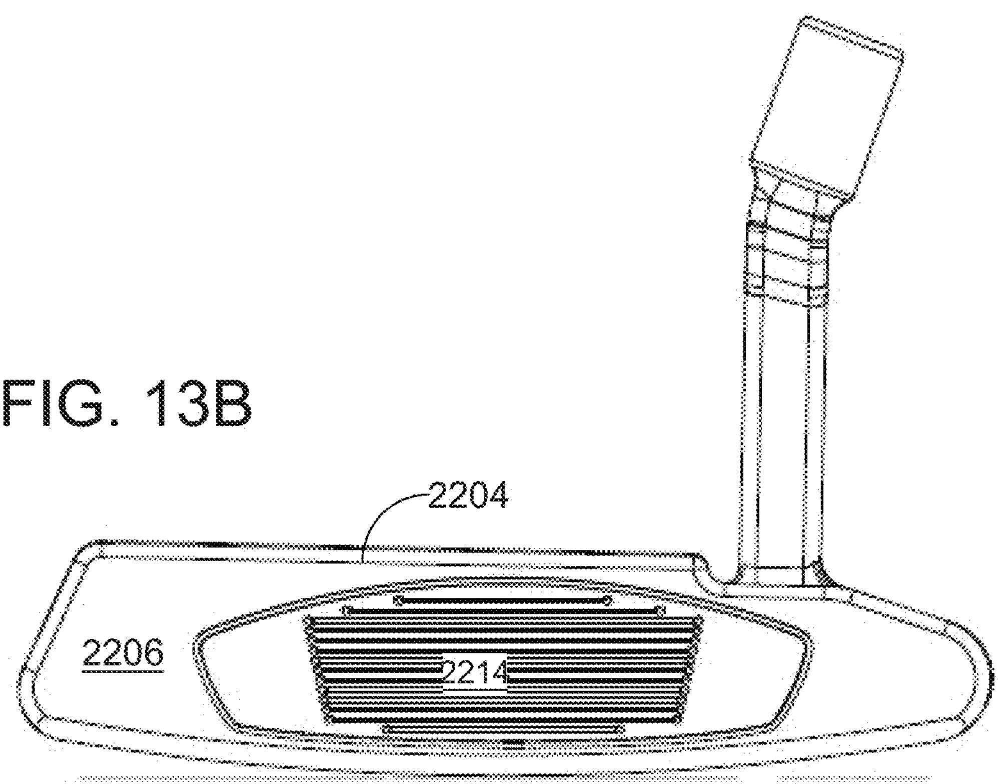


FIG. 13B

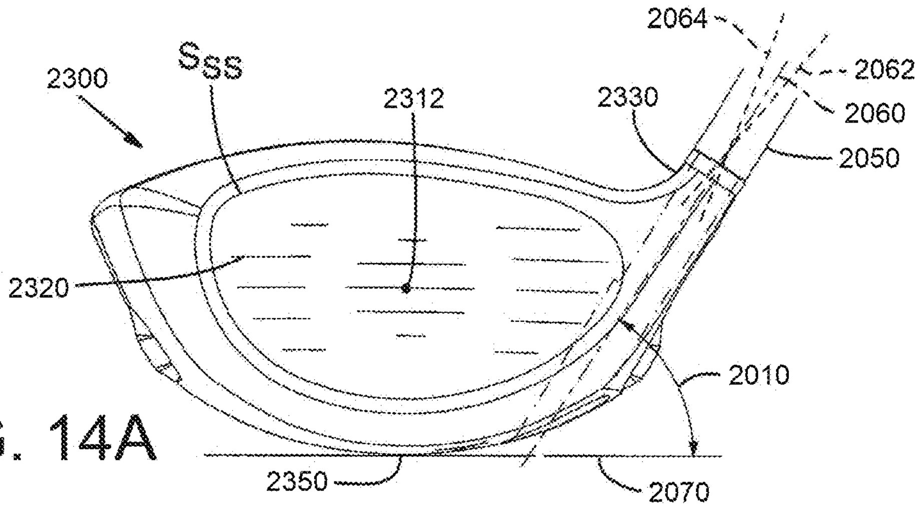


FIG. 14A

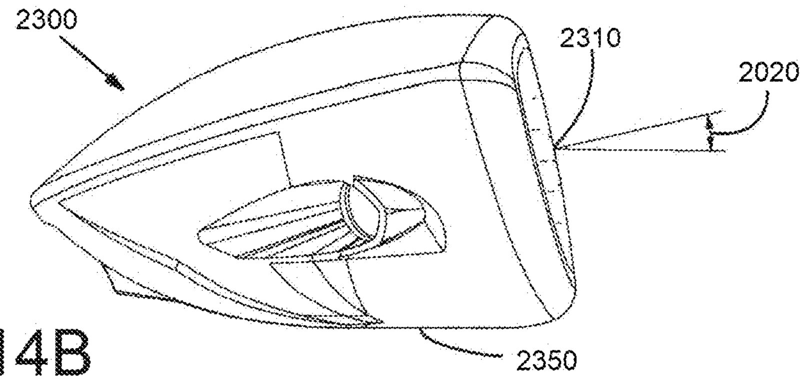


FIG. 14B

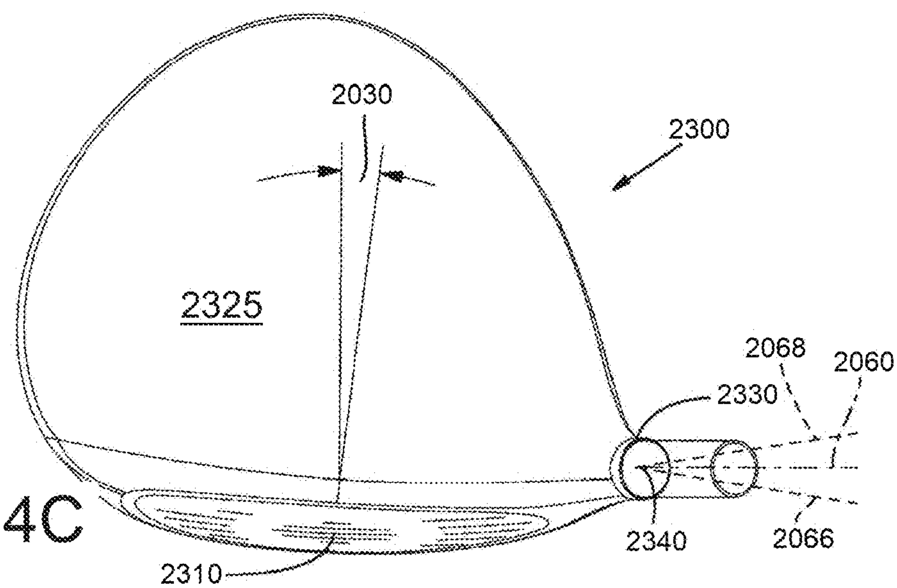


FIG. 14C

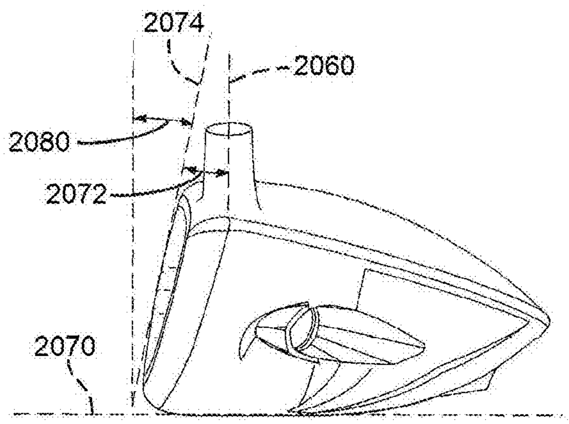


FIG. 14D

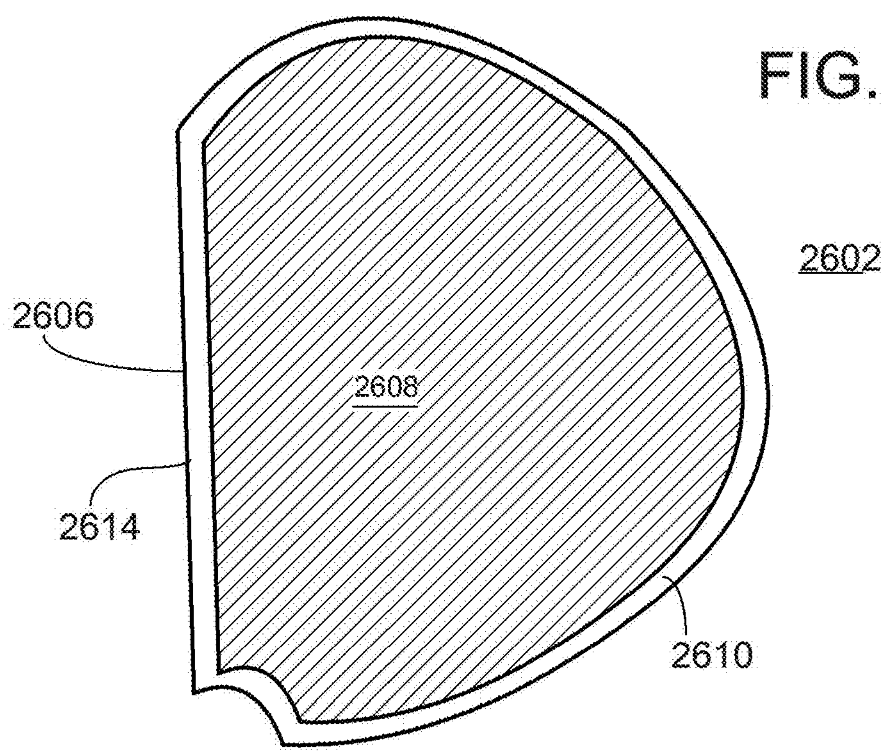


FIG. 17

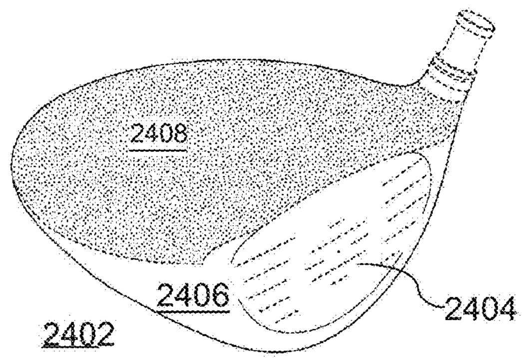


FIG. 15A

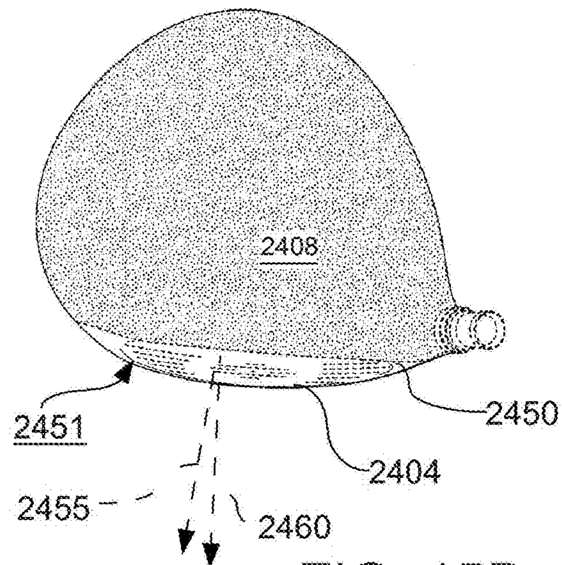


FIG. 15B

FIG. 15C

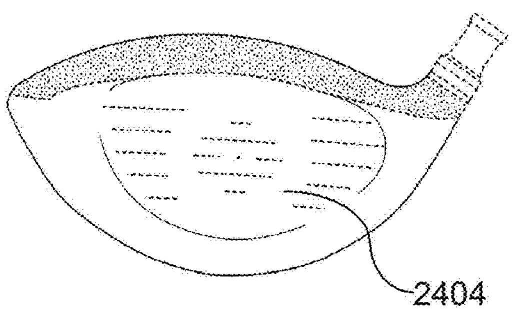
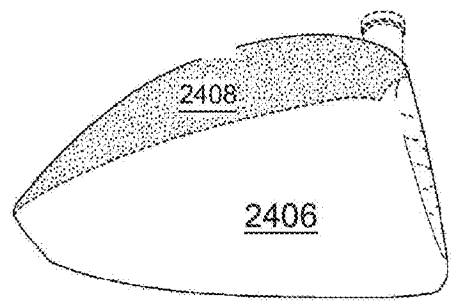


FIG. 15D



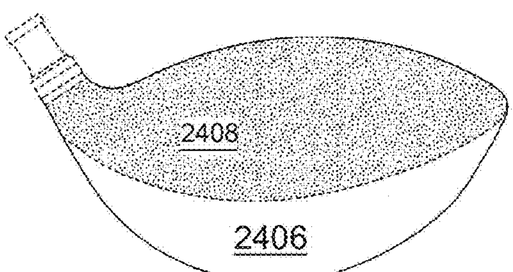


FIG. 15E

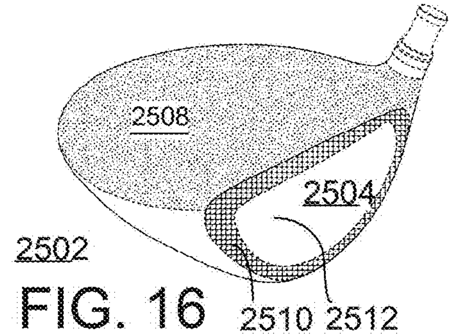


FIG. 16

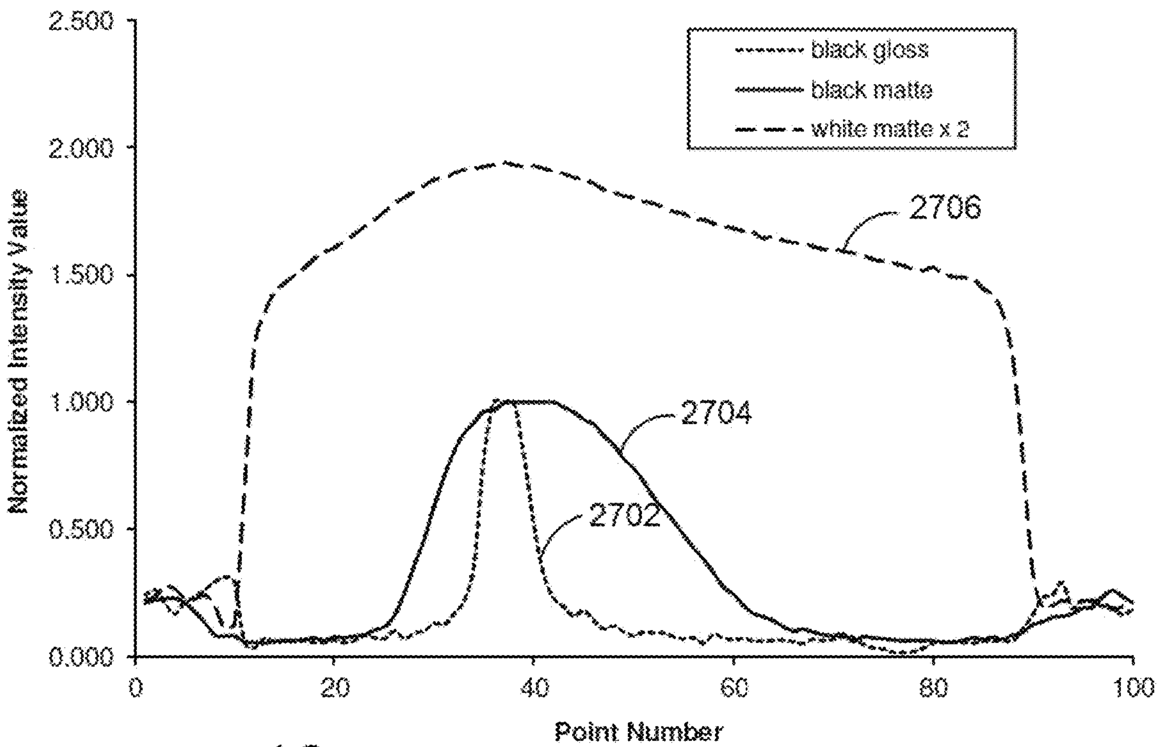

2.500
2.000
1.500
1.000
0.500
0.000
Normalized Intensity Value
0
20
40
60
80
100
Point Number
black gloss
black matte
white matte x 2
2706
2704
2702

FIG. 18

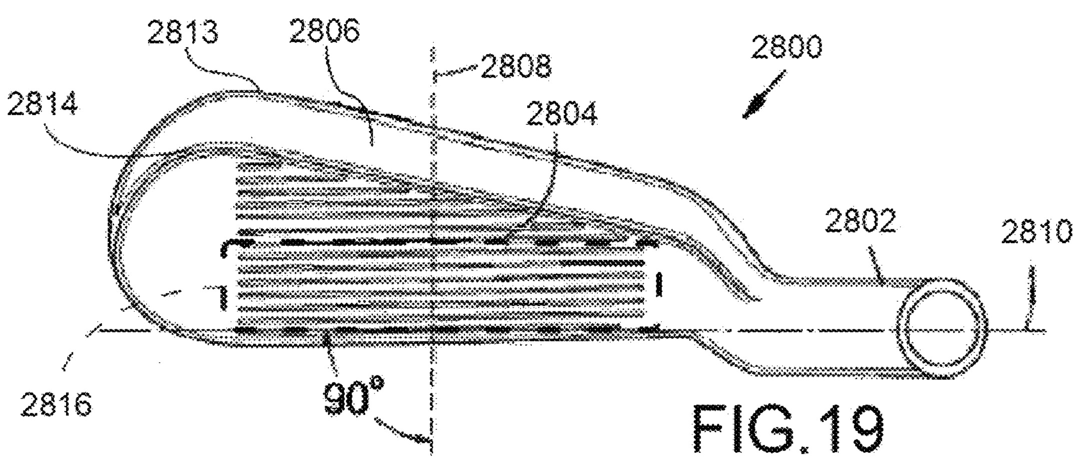

2813
2806
2808
2800
2814
2804
2802
2810
2816
90°

FIG. 19

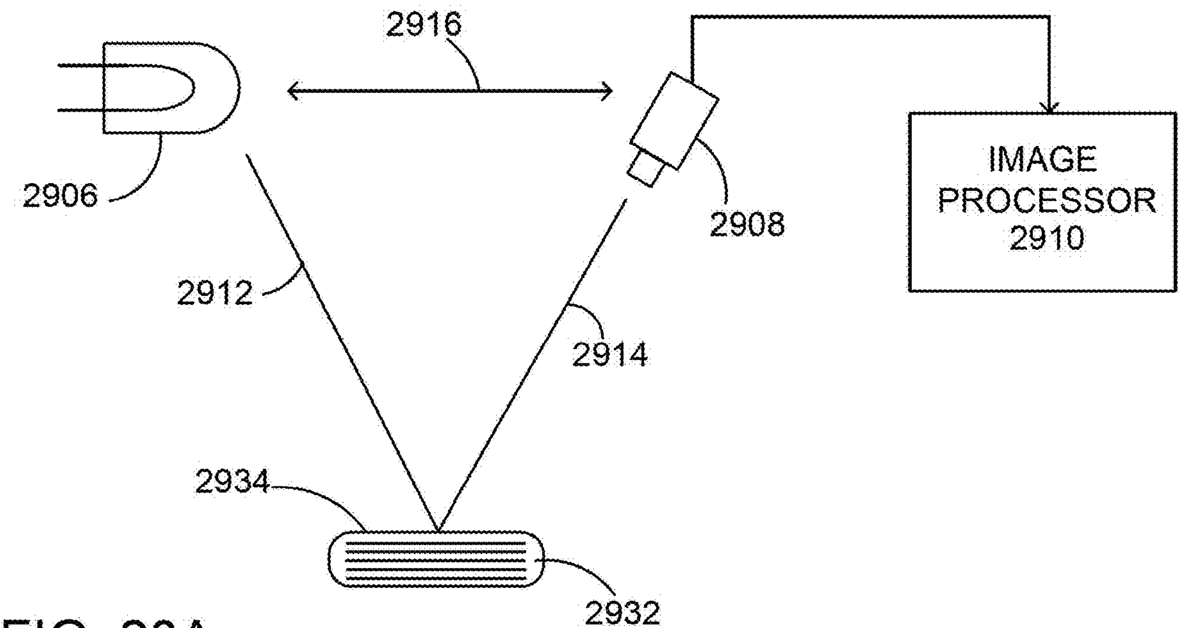


FIG. 20A

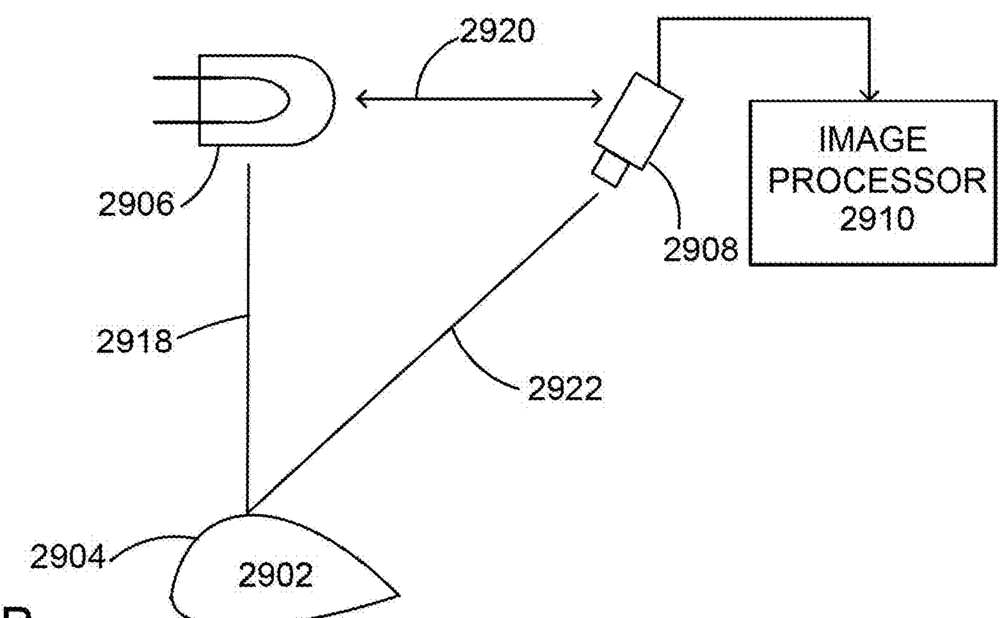


FIG. 20B

FIG. 21

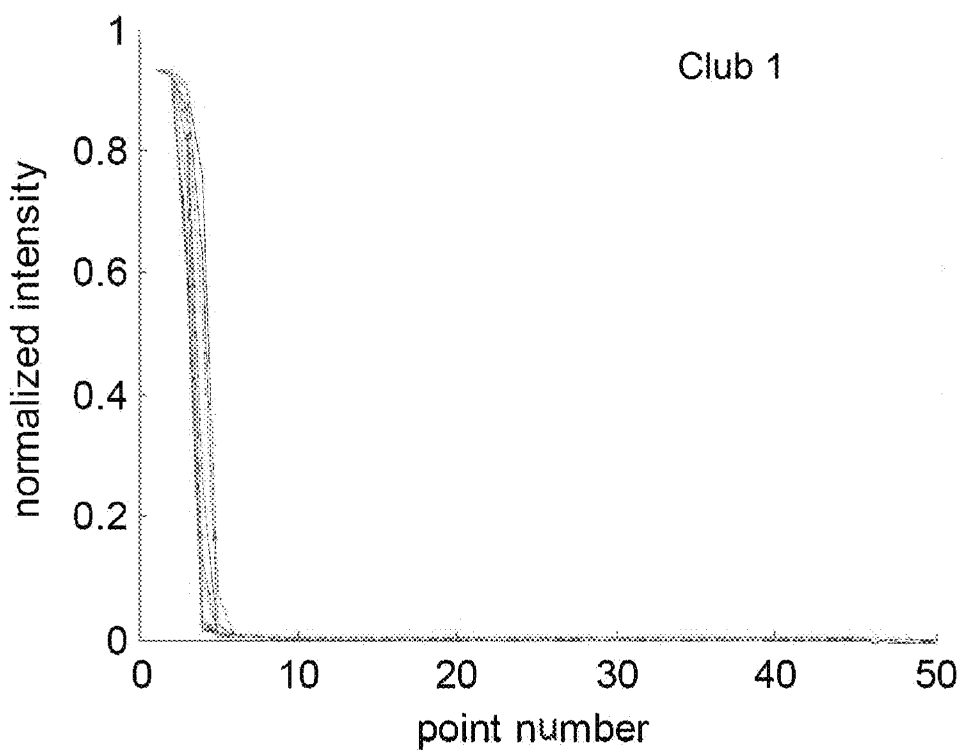

Club 1
normalized intensity
point number
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50

FIG. 22

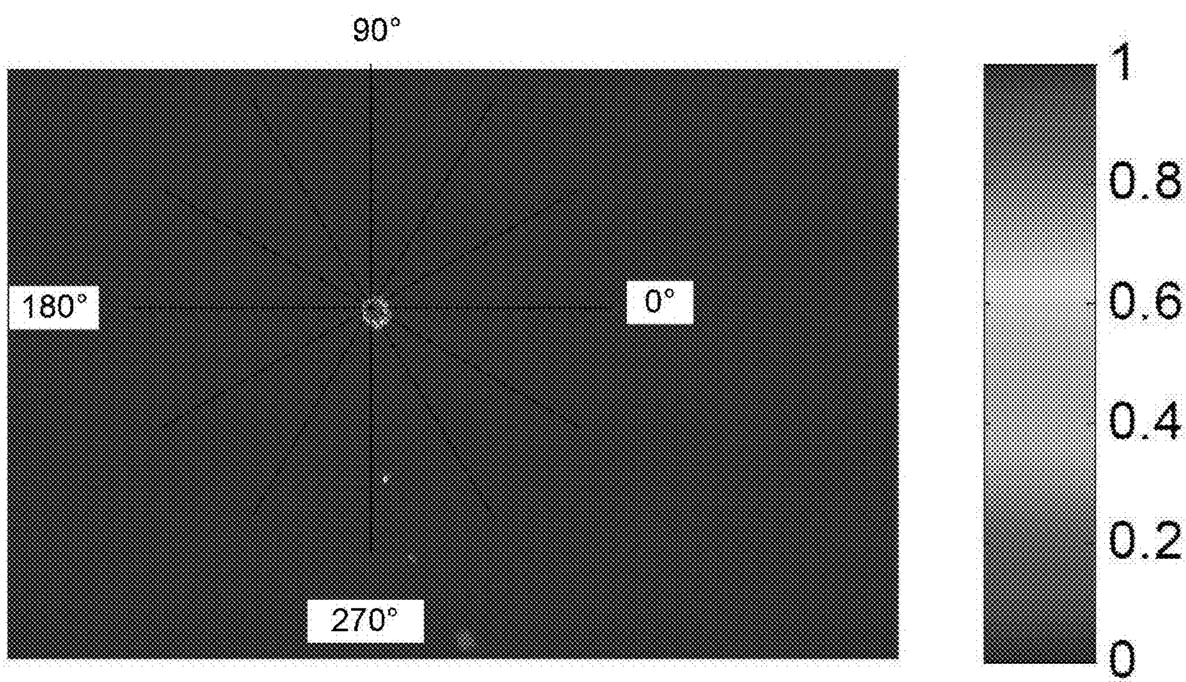


FIG. 23

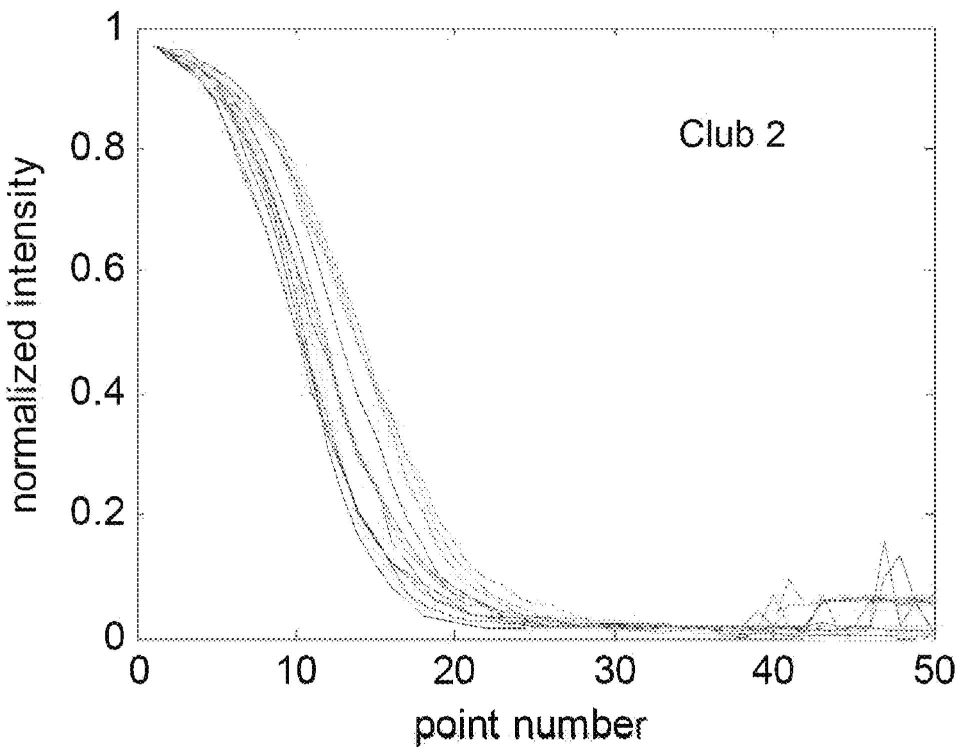

Club 2
normalized intensity
point number
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50

FIG. 24

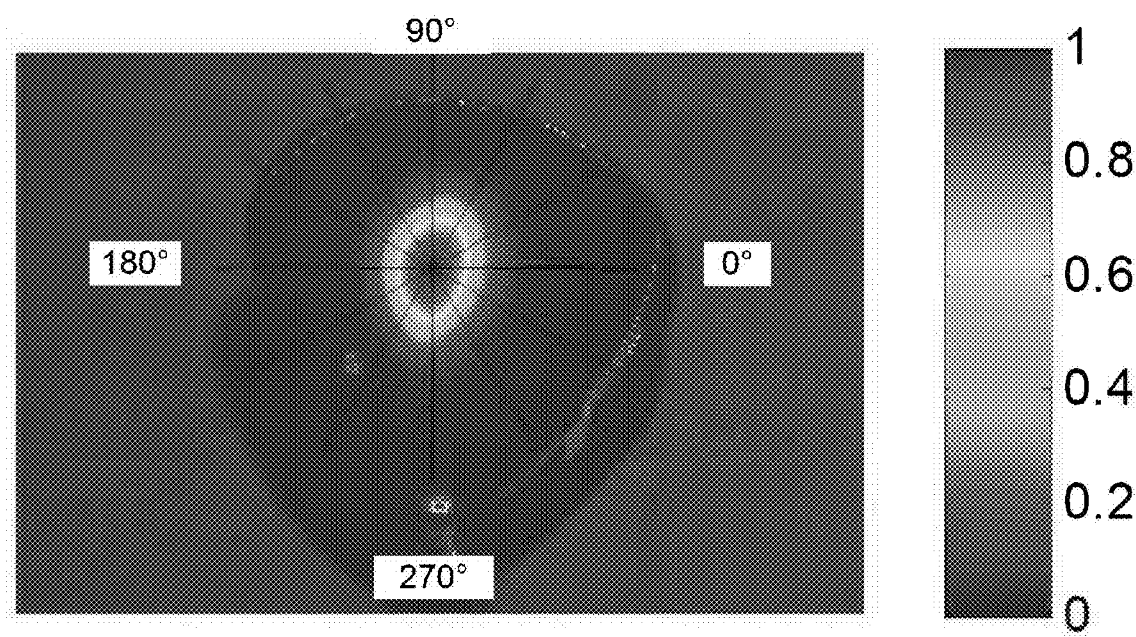
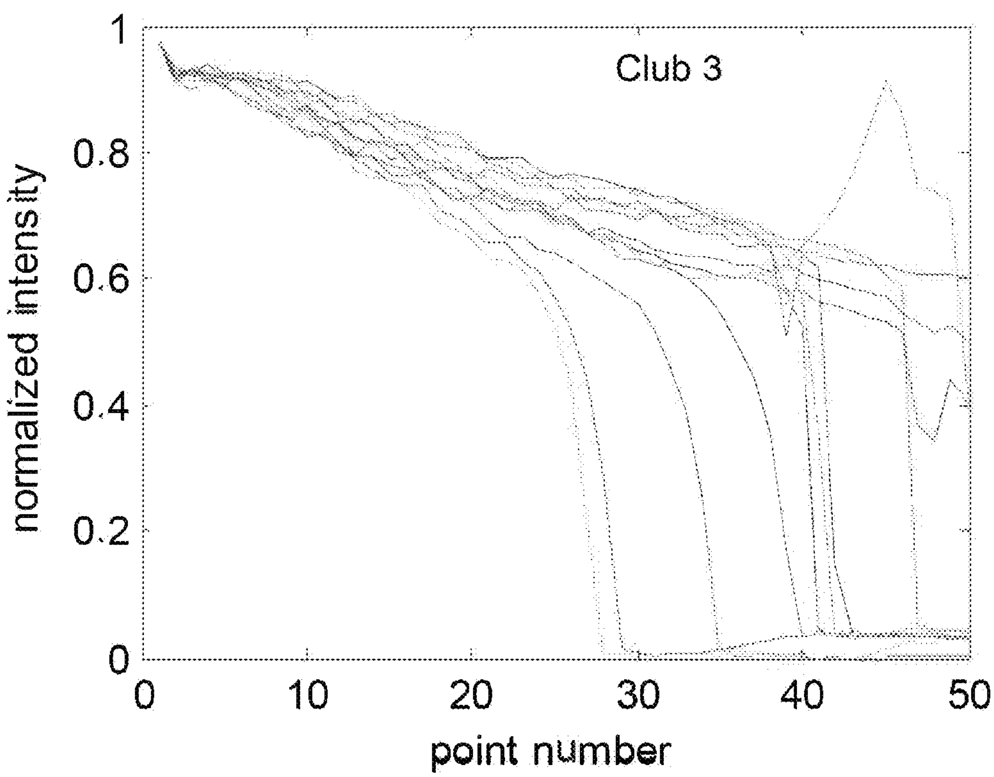


FIG. 25


Club 3
normalized intensity
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0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
point number

FIG. 26

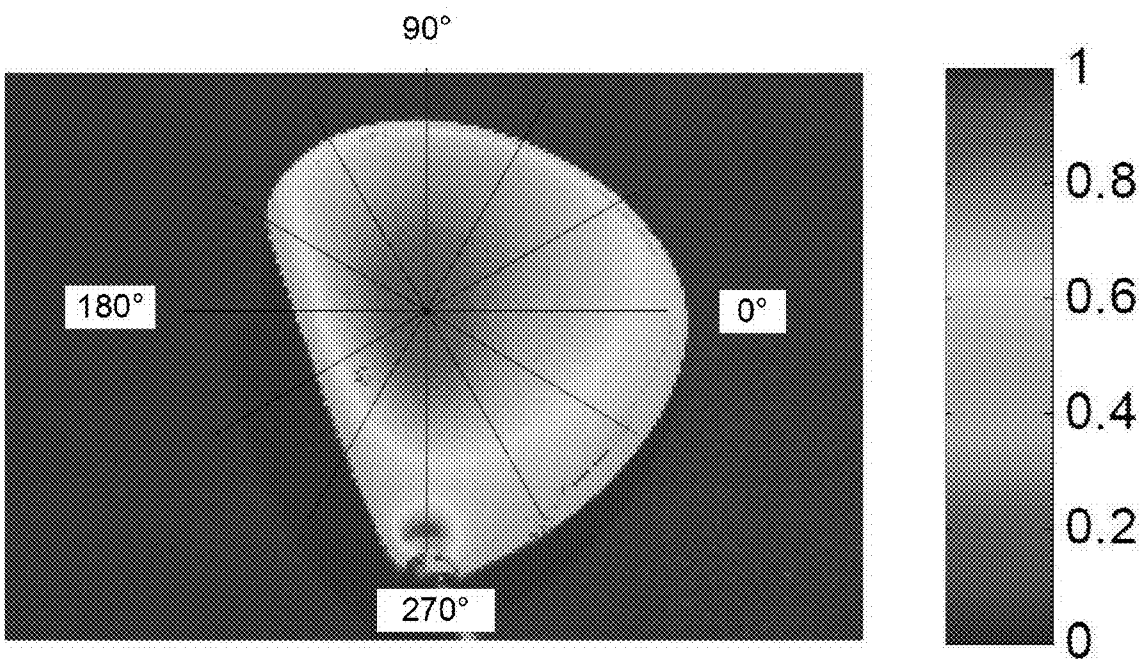
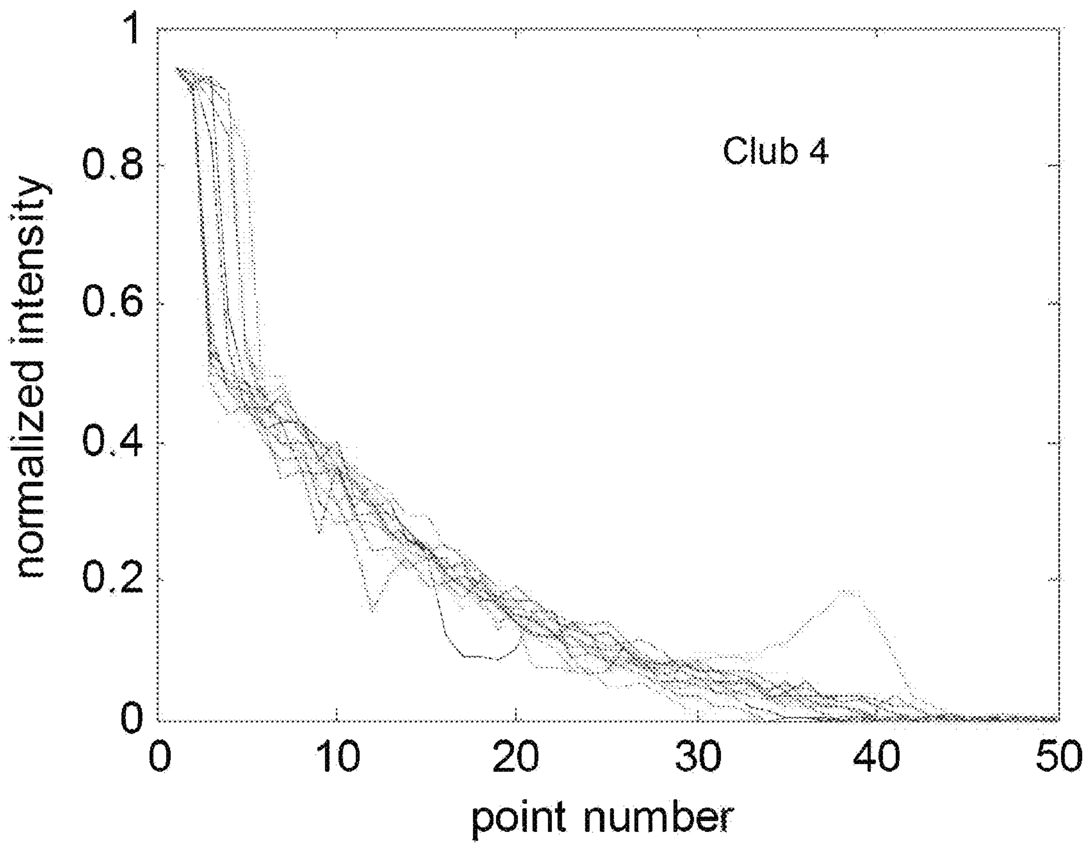


FIG. 27



Club 4
normalized intensity
point number
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50

FIG. 28

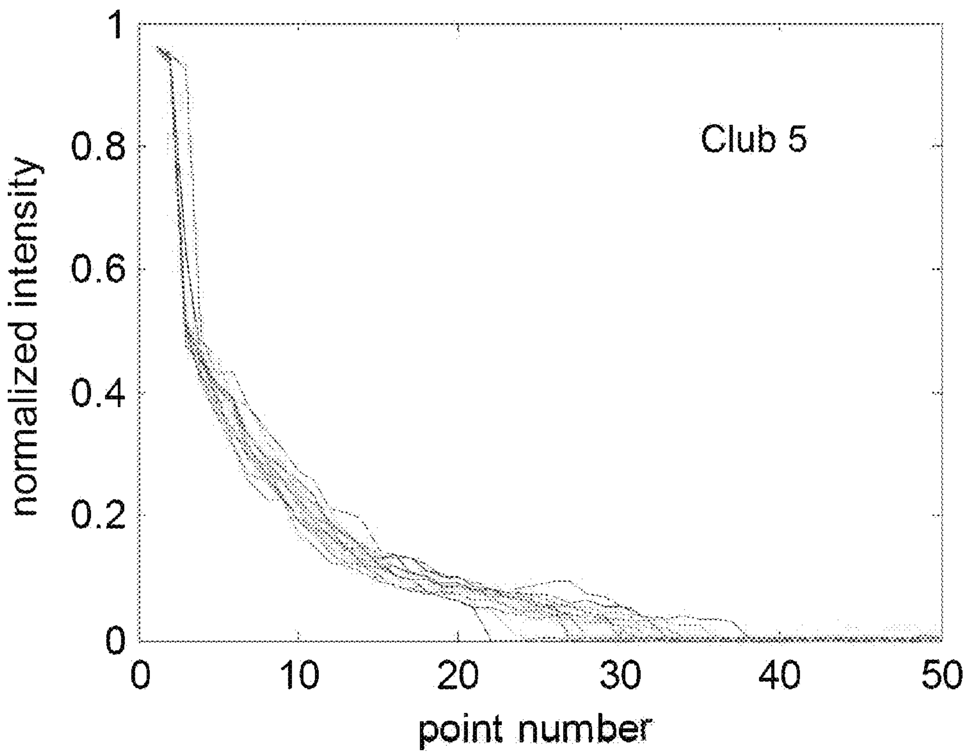

Club 5
normalized intensity
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50
point number

FIG. 29

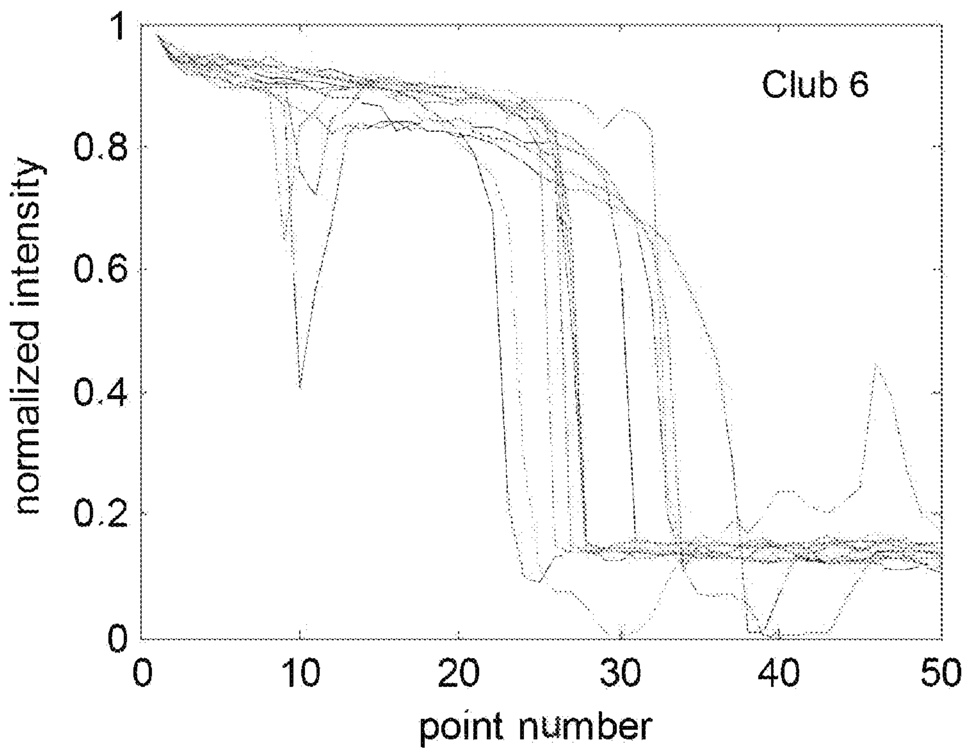

Club 6
normalized intensity
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
point number

FIG. 30

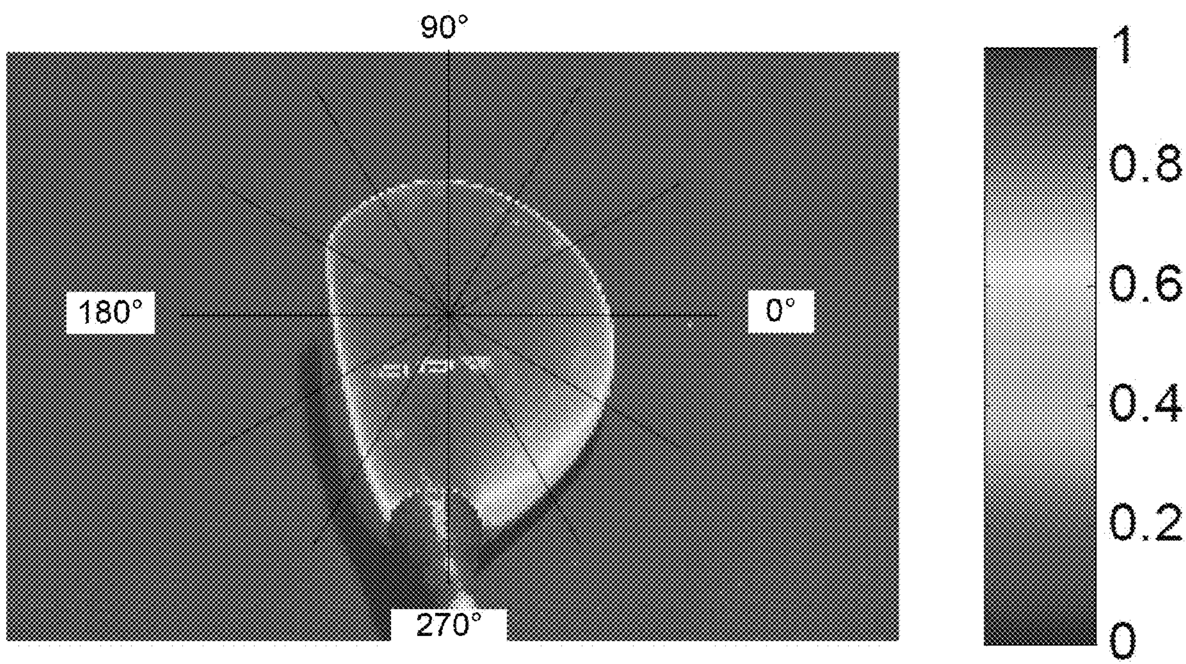


FIG. 31

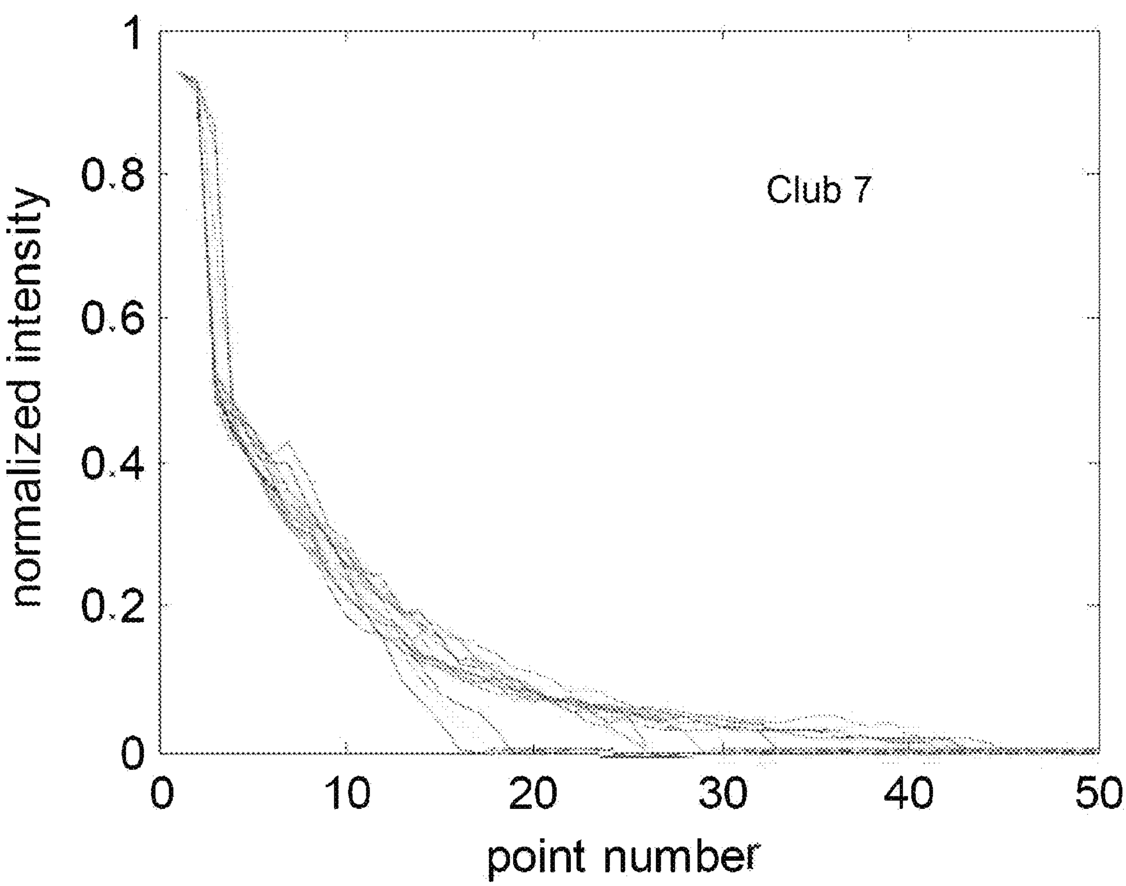
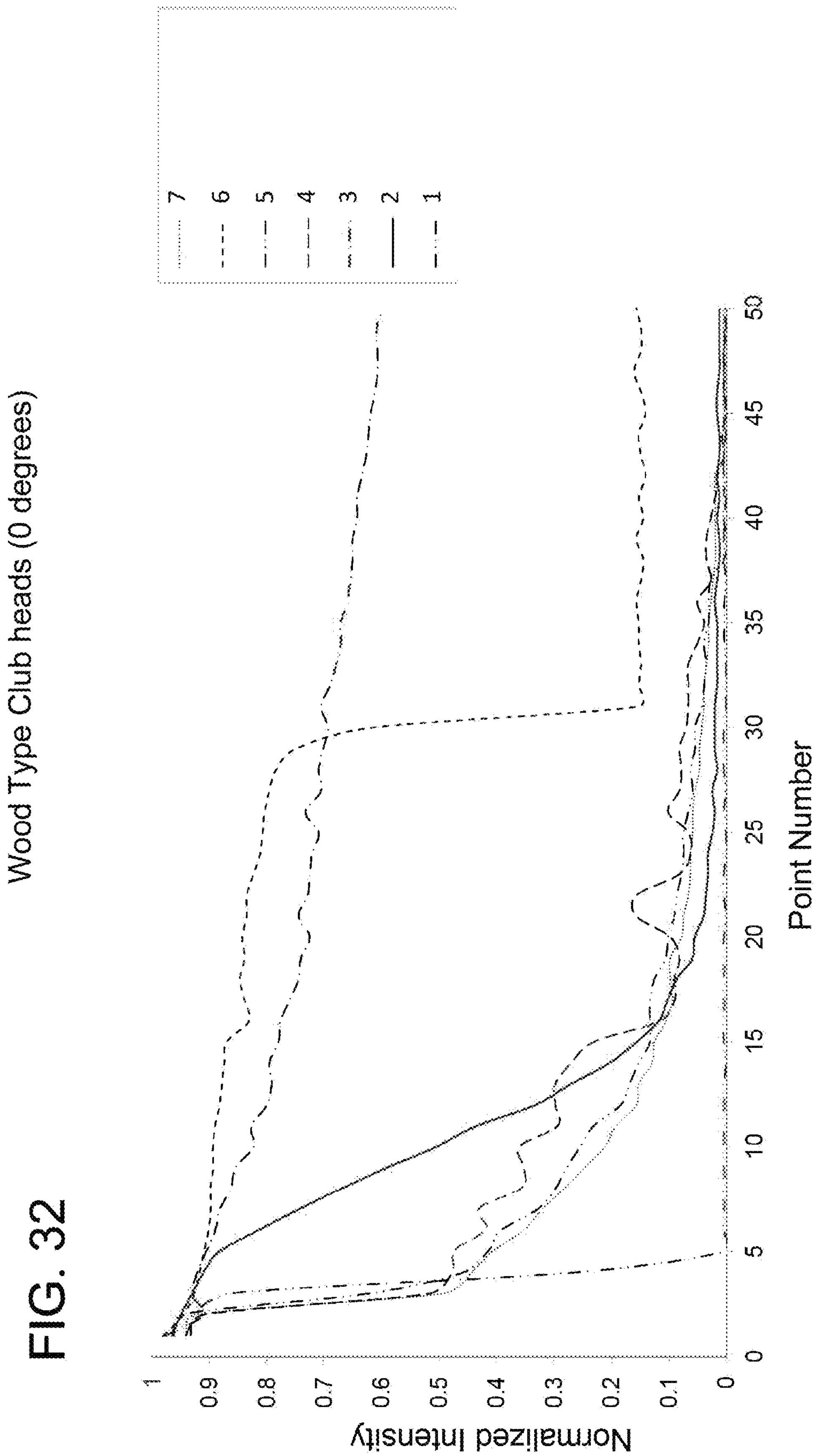

Club 7
normalized intensity
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50
point number

FIG. 32



Wood Type Club heads (0 degrees)
Normalized Intensity
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Point Number
0
5
10
15
20
25
30
35
40
45
50
7
6
5
4
3
2
1

FIG. 33

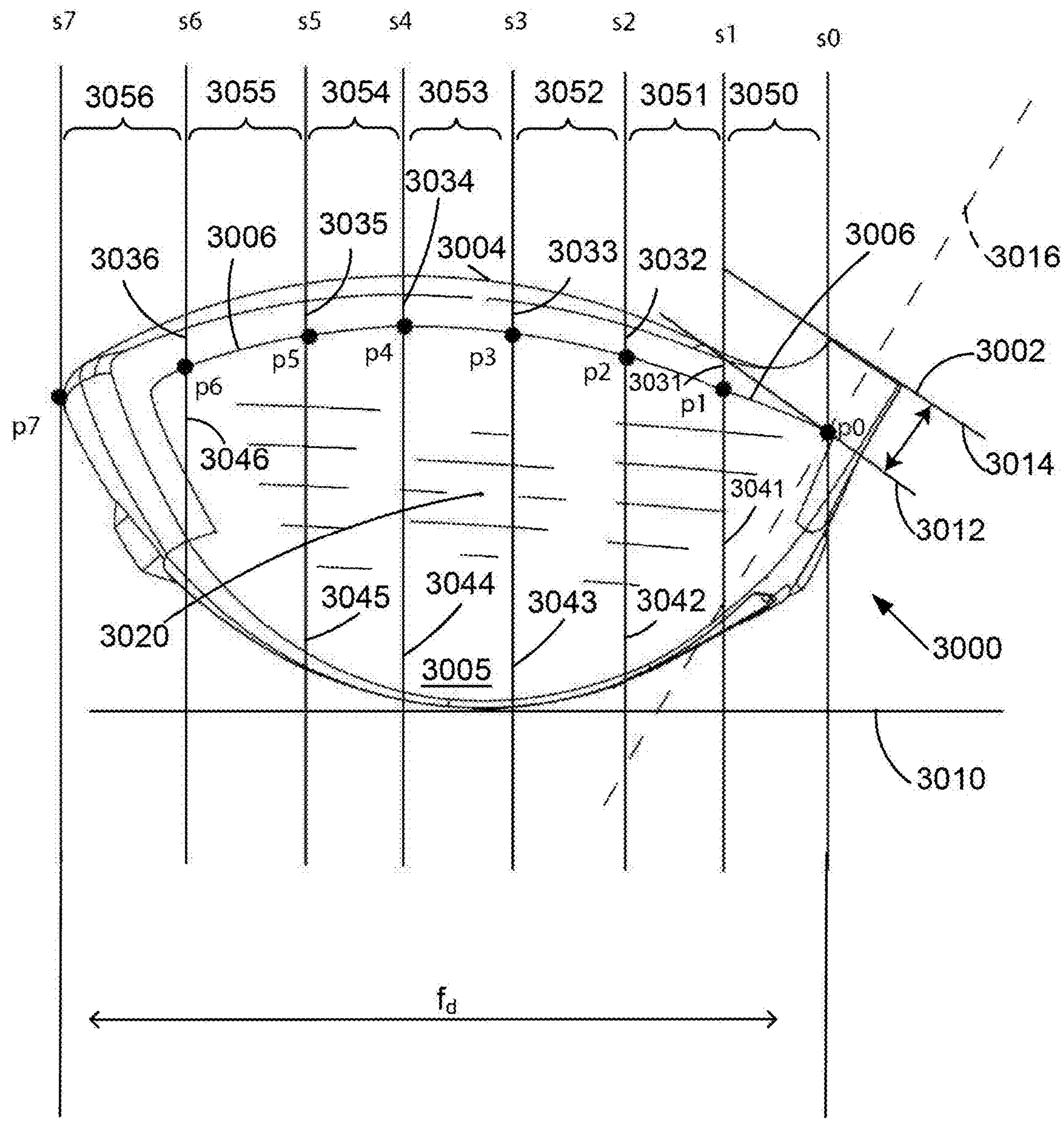

s7
s6
s5
s4
s3
s2
s1
s0
3056
3055
3054
3053
3052
3051
3050
3034
3035
3006
3004
3033
3032
3036
3006
3016
3002
3031
p1
p0
p2
p3
p4
p5
p6
p7
3046
3041
3014
3012
3020
3045
3044
3043
3042
3005
3000
3010
f_d

FIG. 34

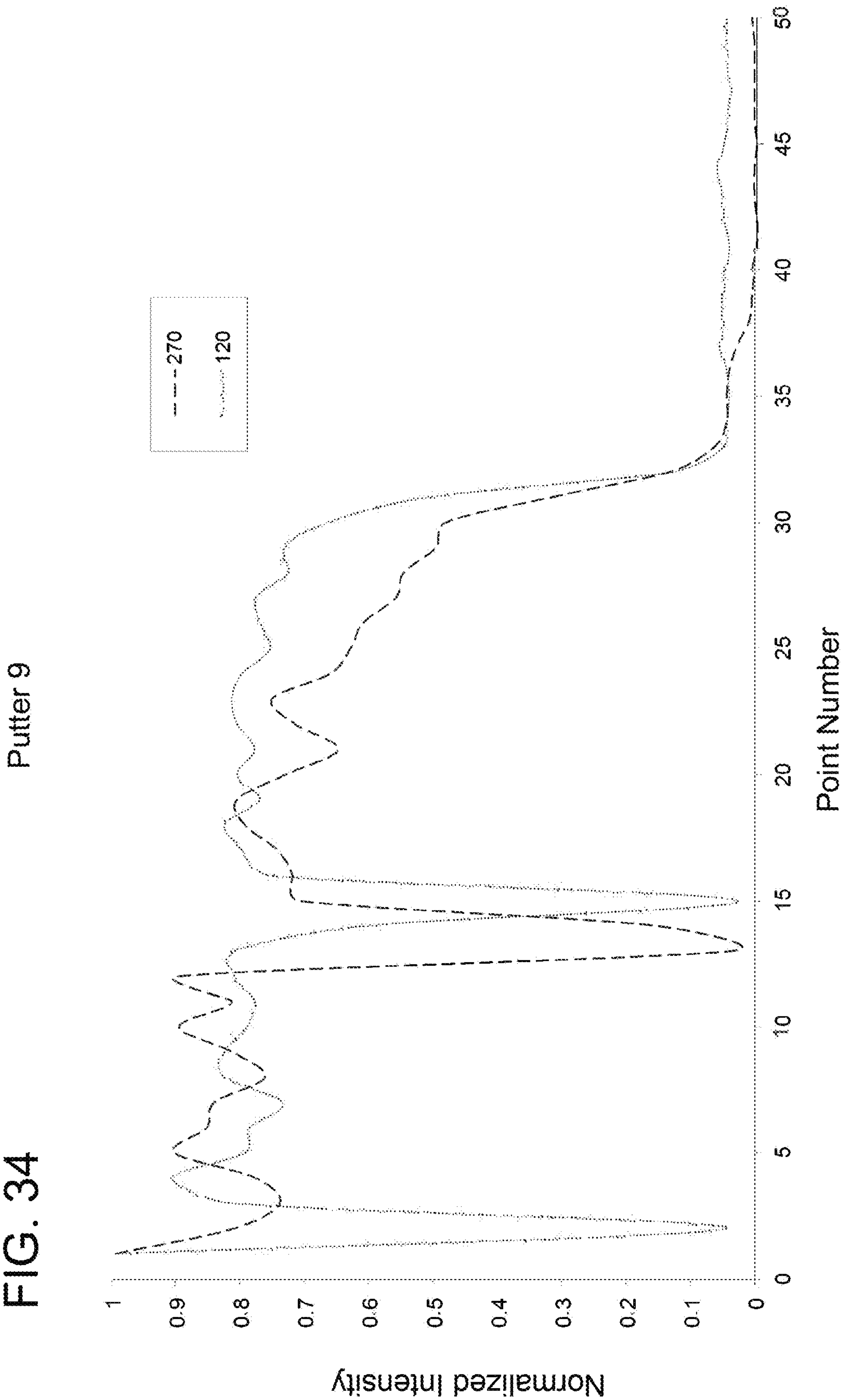

Putter 9
270
120
Normalized Intensity
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Point Number
0
5
10
15
20
25
30
35
40
45
50

FIG.35

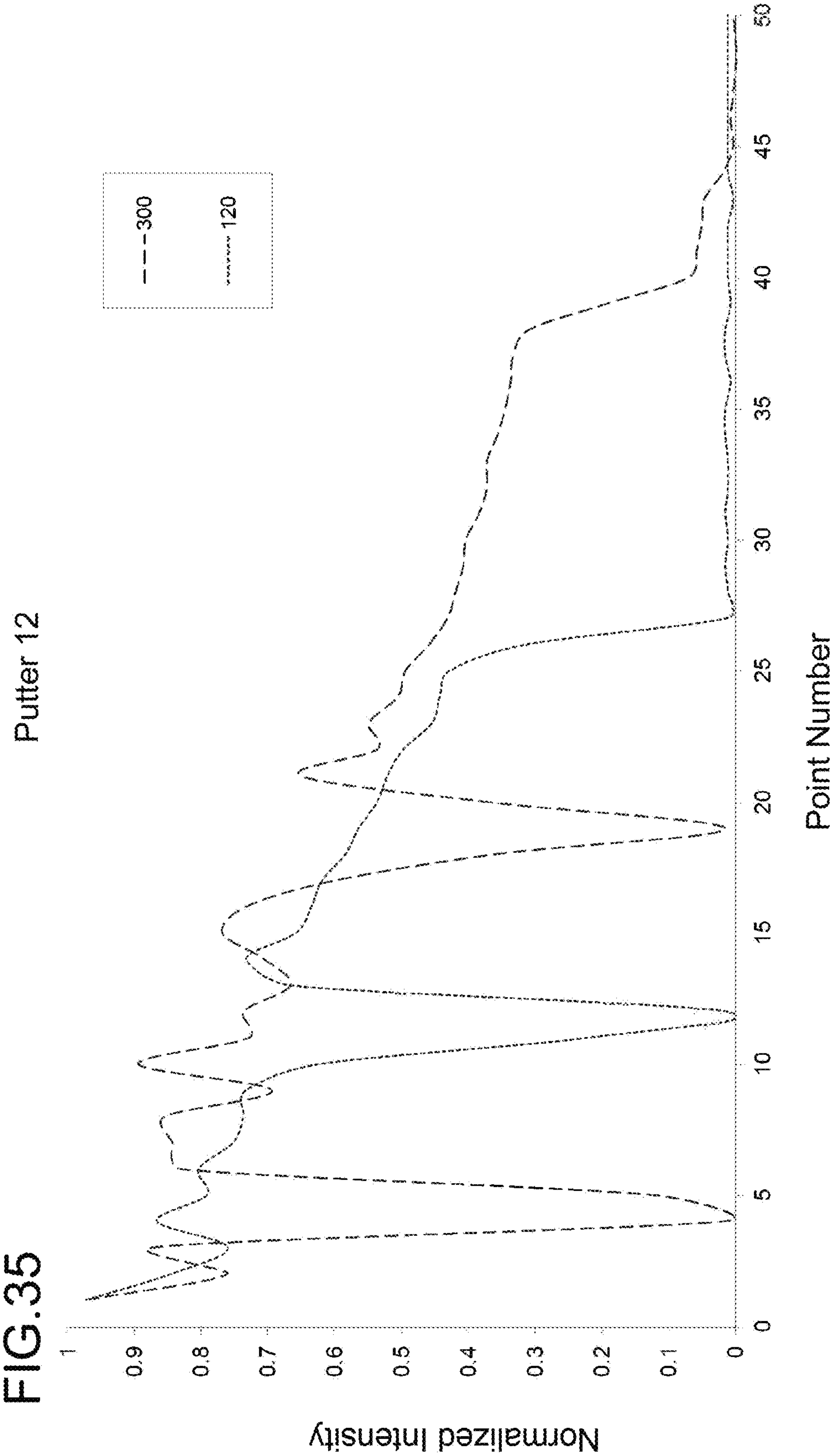

Putter 12
300
120
Normalized Intensity
Point Number
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50

FIG. 36

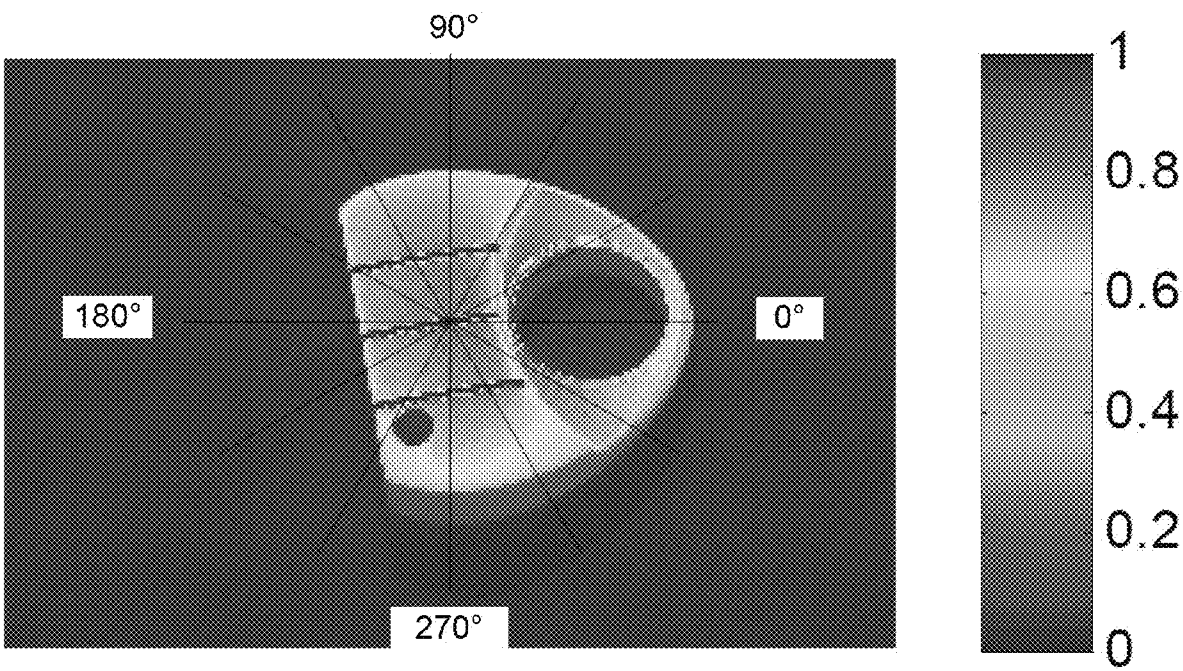


FIG. 37

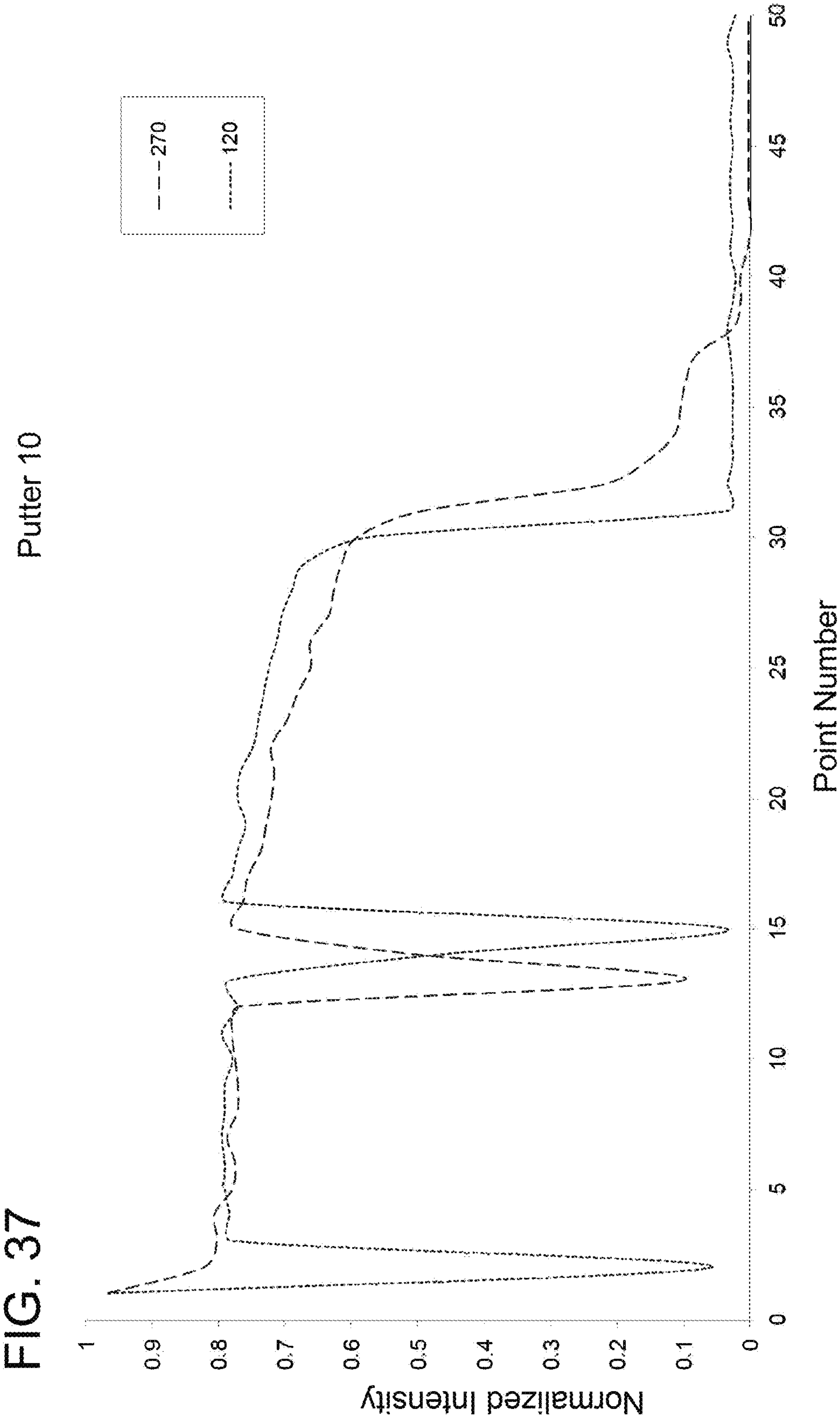

Putter 10
270
120
Normalized Intensity
Point Number
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50

FIG. 38

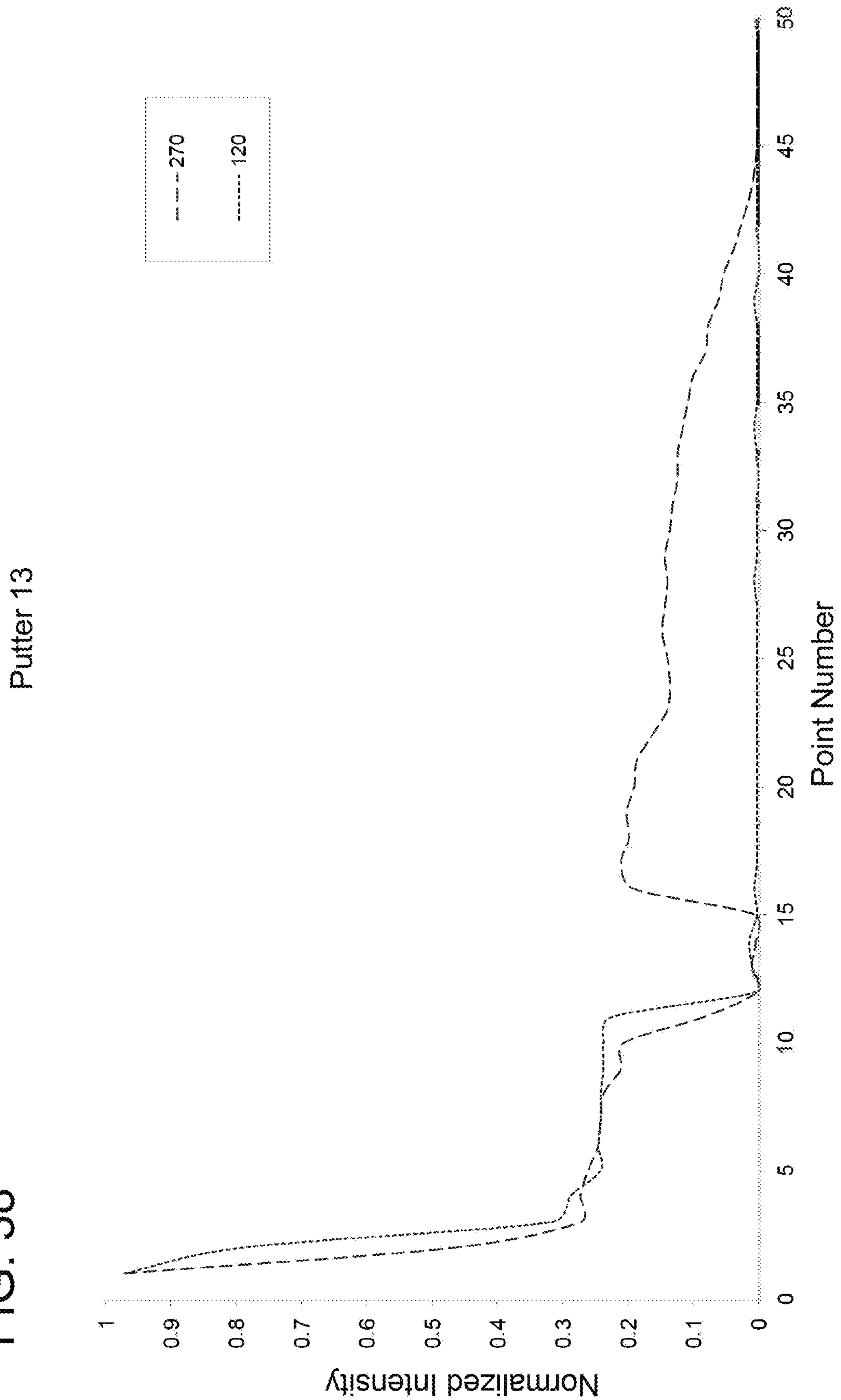

Putter 13
270
120
Normalized Intensity
Point Number
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
5
10
15
20
25
30
35
40
45
50

FIG. 39

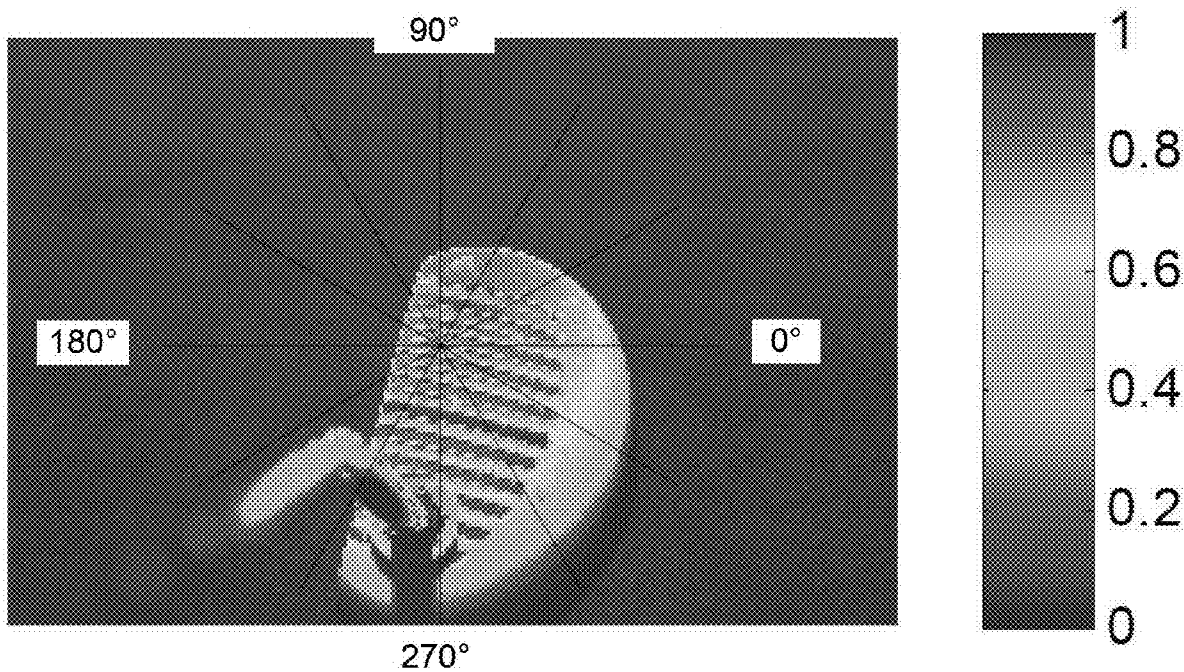
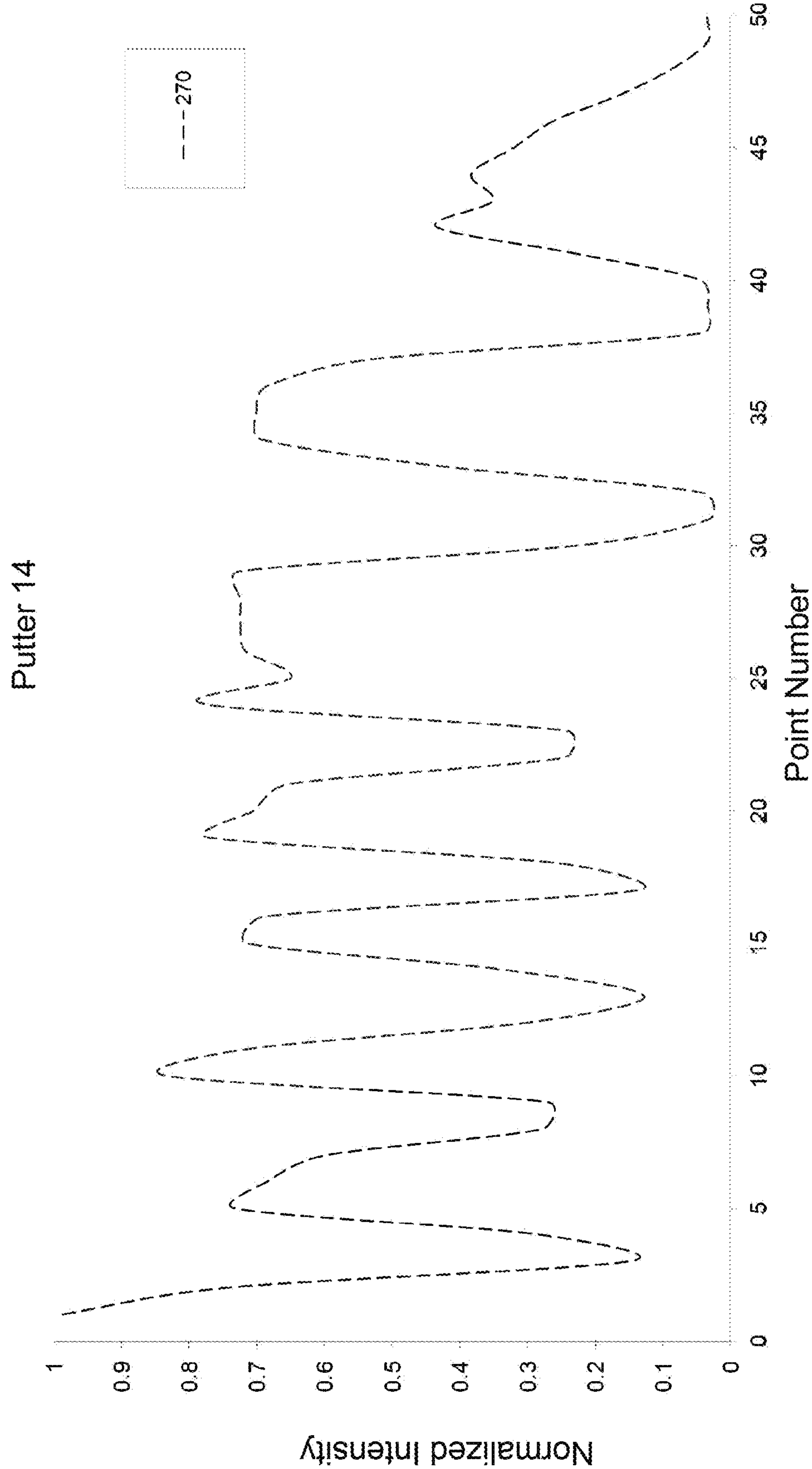


FIG. 40


Putter 14
270
Point Number
Normalized Intensity
0
5
10
15
20
25
30
35
40
45
50
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

GOLF CLUB

REFERENCE TO RELATED APPLICATIONS

This application is a continuation of and claims priority to U.S. patent application Ser. No. 17/695,194, filed on Mar. 15, 2022, which is a continuation of and claims priority to U.S. patent application Ser. No. 16/352,537, filed on Mar. 13, 2019, which is a continuation of and claims priority to U.S. patent application Ser. No. 16/046,106, filed Jul. 26, 2018, now abandoned, which is a continuation of and claims priority to U.S. patent application Ser. No. 15/197,551, filed Jun. 29, 2016, now U.S. Pat. No. 10,052,530, which claims benefit of priority under 35 U.S.C. § 1 19(e) to Provisional Application No. 62/185,882 entitled "GOLF CLUB" filed Jun. 29, 2015, both of which are incorporated by reference herein in their entirety. This application references U.S. Pat. No. 8,771,095 to Beach, et. al, entitled "CONTRAST-ENHANCED GOLF CLUB HEADS," filed Mar. 18, 2011.

TECHNICAL FIELD

This disclosure relates to golf clubs. More specifically, this disclosure relates to golf club alignment.

SUMMARY

Aspects of the invention are directed to golf club heads including a body having a face, a crown and a sole together defining an interior cavity, the golf club body including a heel and a toe portion and having x, y and z axes which are orthogonal to each other having their origin at USGA center face and wherein the golf club head has a primary alignment feature comprising a paint or masking line which delineates the transition between at least a first portion of the crown having an area of contrasting shade or color with the shade or color of the face.

In some embodiments the golf club head includes a body having a face, a sole and a crown, the crown having a first portion having a first color or shade and a second portion having a second color or shade, the face crown and sole together defining an interior cavity, the golf club body including a heel and a toe portion and having x, y and z axes which are orthogonal to each other having their origin at USGA center face and wherein the golf club head has a primary alignment feature comprising a paint or masking line which delineates the transition between at least a first portion of the crown having an area of contrasting shade or color and the area of shade or color of the face, and the club head also includes a secondary alignment feature including a paint or masking line which delineates the transition between the first portion of the crown having an area of contrasting shade or color with the shade or color of the face; and a second portion of the crown having an area of contrasting shade or color with the shade or color of the first portion, the secondary alignment feature comprising a first elongate side having a length of from about 0.5 inches to about 1.7 inches, and a second and third elongate side extending back from the face and rearward from and at an angle to the first elongate side.

In some embodiments the golf club heads have a body having a face, a crown and a sole together defining an interior cavity, the golf club body also includes a heel and a toe portion and a portion of the crown comprises an electronic display, wherein the electronic display includes an organic light-emitting diode (OLED) display for providing active color and wherein the OLED display is divided into independently operating electronic display zones.

In some examples, golf club heads comprise a crown having at least an upward facing surface portion provided with a diffused surface treatment as viewed from an address orientation, wherein the diffused surface treatment defines a highest reflected intensity location on the crown in response to illumination from a light source situated within a cone of angular radius of about 30 degrees above the crown and a secondary location situated on the crown at a distance of at least 20% of a crown effective length from the highest reflected intensity location having a reflected intensity of at least 25% of the highest reflected intensity. The golf club head also includes a striking surface situated so as to define an interface with the crown. In some embodiments, the crown effective length is selected from a plurality of pixel radii having a 30 degree angular spacing and radiating from the highest reflected intensity location to an edge of the crown. In other examples, the crown effective length is associated with a toe-to-heel direction, a direction perpendicular thereto, or an angle that is an integer multiple of 5 degrees with respect to the toe-to-heel direction. In still other examples, a zone of crown intensity is defined from the crown effective length in a direction of 30 degrees and negative 30 degrees from the crown effective length orientation, wherein the reflected intensity is at least 20% of the highest reflected intensity within a distance of at least 20%, 40%, or 60% of the crown effective length from the highest reflected intensity location. In representative examples, the secondary location is situated on the crown at a distance of at least 30%, 40%, 50%, or 60% of the crown effective length from the highest reflected intensity location.

In some example embodiments, a plurality of secondary locations are situated on the crown at distances of at least 50% of the crown effective length along a respective plurality of pixel radii situated at angles of at least 30 degrees with respect to each other such that the secondary locations are situated on the crown a distance of at least 50% of a respective pixel radius and are associated with reflected intensities of at least 50% of the highest reflected intensity. In some particular examples, the secondary locations are situated on the crown a distance of at least 75% of the respective pixel radii and are associated with reflected intensities of at least 70% of the highest reflected intensity. In other representative examples, the diffused surface treatment is a white surface treatment associated with a gloss value of less than about 60.

In some embodiments, a transparent matte coating is situated on at least the upward facing portion of the crown, wherein the transparent matte surface is a semigloss or low gloss surface. In typical examples, the transparent matte coating has a gloss value of less than 60 gloss units. In other examples, at least the upward facing portion of the crown surface has a chroma value of less than 5 and at least a top portion of the face surface adjacent the crown has a black surface treatment. In representative examples, at least the top portion of the face surface has a gloss value of less than 50 gloss units, or the black surface treatment has a chroma of less than one and a brightness of less than 50. In additional examples, the face surface has a black surface treatment having a chroma of less than 1.0 and a brightness of less than 50, and at least the upward facing portion of the crown surface has a chroma value of less than 5 and a brightness greater than 85.

Metal wood-type golf club heads include a body comprising a face plate positioned at a forward portion of the golf club head, a sole positioned at a bottom portion of the golf club head, a crown positioned at a top portion of the golf club head and a skirt positioned around a periphery of the golf club head between the sole and the crown. The head has a golf club head origin positioned on the face plate at an approximate geometric center of the face plate, the head origin including an x-axis tangential to the face plate and generally parallel to the ground when the head is in an address position, a y-axis generally perpendicular to the x-axis and generally parallel to the ground when the head is in an address position, and a z-axis generally perpendicular to the x-axis and to the y-axis and generally perpendicular to the ground when the head is in an address position. A positive x-axis extends toward a club head heel, a positive y-axis extends toward the cavity, and a positive z-axis extends away from the ground with the head in the address position. At least a perimeter portion of the crown adjacent a top portion of the faceplate and having an area that is at least 5% of the crown area has a bright, diffusely reflecting surface, and at least a top perimeter portion of the face plate has a dark diffusely reflecting surface area. In some embodiments, the bright, diffusely reflecting portion of the crown is white and includes at least the upper facing portion of the crown, and the face plate surface is a dark diffusely reflecting surface. In other examples, the bright, diffusely reflecting portion of the crown has a chroma value of less than 5, and the face plate surface has a chroma value of less than 1. In additional representative examples, the bright, diffusely reflecting portion of the crown has a brightness of at least 80.

In some examples, at least a portion of the crown adjacent a top perimeter of the face plate has a semigloss surface with a chroma value of less than 10 and a brightness of at least 50. In other examples, the bright diffusely reflecting surface extends over at least 80% of the upward facing crown area or the crown surface has a CIELab brightness of between 50 and 100, and a gloss value of less than 60 gloss units. In still further examples, the dark, diffusively reflecting face plate surface area has a CIELab brightness of less than 40 and a chroma of less than 10 or the face plate has a gloss value of less than 60 gloss units. In other examples, a difference in L* values between the crown and the face is high contrast for more than about 14.3%, 28.6%, 42.9%, 57.1%, 71.4%, or 85.7% of the face distance.

Putter heads comprise a crown having at least an upward facing surface portion provided with a white diffusing surface treatment as viewed from an address orientation, and a striking face that includes a dark surface portion. In some examples, the crown has a CIELab L* value of between 50 and 100, a chroma of less than 2, a hue of between 235 degrees and 270 degrees. The white diffusing surface treatment extends over at least 90% of the upward facing surface portion and has a gloss that is less than 60 gloss units. In other examples, the crown has a CIELab L* value of between 64 and 93, a chroma of less than 4, and the white diffusing surface treatment extends over at least 80% of the upward facing surface portion and is a semigloss surface treatment. In still further embodiments, the crown has a CIELab L* value of between 88 and 93, a chroma of between 3 and 4, a hue between 215 and 235, and the white diffusing surface treatment extends over at least 60% of the upward facing surface portion and is a semigloss surface treatment.

In other embodiments, golf club heads comprise a crown having at least an upward facing surface portion provided with a diffused surface treatment as viewed from an address orientation, wherein the white surface treatment defines a highest reflected intensity location on the crown in response to illumination from a light source situated within a cone of angular radius of about 30 degrees above the crown. A secondary location situated on the crown a distance of at least 50% of a crown effective length from the highest reflected intensity location has a reflected intensity of at least 25% of the highest reflected intensity. A striking surface is situated so as to define an interface with the crown. In some examples, the secondary location is situated on the crown a distance of at least 20%, 30%, 40%, 60%, 75%, or 85% of the crown effective length from the highest reflected intensity location, and has a reflected intensity of at least 50% or 70% of the highest reflected intensity.

In some examples, a plurality of secondary locations are situated on the crown at distances of at least 50% of a pixel radius along a respective plurality of pixel radii situated at angles of at least 30 degrees with respect to each other such that the secondary locations are situated on the crown a distance of at least 50% of a respective crown effective length from the highest intensity location and are associated with reflected intensities of at least 50% of the highest reflected intensity. In some examples, the white surface treatment defines a semigloss surface that is associated with a gloss value of less than about 60 or 40.

In additional examples, a transparent matte coating is situated on at least the upward facing portion of the crown, wherein the transparent matte surface is a semigloss or low gloss surface, having a gloss value of less than 60 gloss units. In some alternatives, at least the upward facing portion of the crown surface has a chroma value of less than 5 or less than 2. In still other examples, at least a top portion of the face surface adjacent the crown has a black surface treatment that is a semigloss or low gloss surface. In some examples, the face surface has a gloss value of less than 60, 50, or 40 gloss units. In particular examples, the black surface treatment has a chroma of less than 1 or 0.9 and a brightness of less than 50 or 30. In some embodiments, the face surface has a black surface treatment having a chroma of less than 1.0 and a brightness of less than 50, and at least the upward facing portion of the crown surface has a chroma value of less than 5 and a brightness greater than 85.

In some examples, metal wood-type golf club heads comprise a body comprising a face plate positioned at a forward portion of the golf club head, a sole positioned at a bottom portion of the golf club head, a crown positioned at a top portion of the golf club head and a skirt positioned around a periphery of the golf club head between the sole and the crown. The head has a golf club head origin positioned on the face plate at an approximate geometric center of the face plate. The head origin includes an x-axis tangential to the face plate and generally parallel to the ground when the head is in an address position, a y-axis generally perpendicular to the x-axis and generally parallel to the ground when the head is in an address position, and a z-axis generally perpendicular to the x-axis and to the y-axis and generally perpendicular to the ground when the head is in an address position, wherein a positive x-axis extends toward a club head heel, a positive y-axis extends toward the cavity, and a positive z-axis extends away from the ground with the head in the address position. At least a perimeter portion of the crown adjacent a top portion of the faceplate and having an area that is at least 5% of the crown area has a bright, diffusely reflecting white surface, and at least a top perimeter portion of the face plate has a dark diffusely reflecting surface area. In other examples, the face plate comprises a plurality of scorelines, wherein the scorelines include a diffusely reflecting surface area that has an intermediate value of reflectance between that of the bright, diffusely reflecting portion of the crown and the dark portion of the face plate. In other embodiments, the bright, diffusely white reflecting portion of the crown includes at least the upper facing portion of the crown, and the face plate surface is a dark diffusely reflecting surface. In representative implementations, the bright, diffusely reflecting portion of the crown has a chroma value of less than 5, and the face plate surface has a chroma value of less than 1. In still further examples, the bright, diffusely reflecting white portion of the crown has a brightness of at least 80 and less than 100. Typically, at least a portion of the crown adjacent a top perimeter of the face plate has a semigloss surface with a chroma value of less than 10 and a brightness of at least 50.

In some example embodiments, least a portion of the crown adjacent a top perimeter of the face plate has a semigloss surface with a chroma value of less than 6 and a lightness of at least 75 or at least a portion of the crown adjacent a top perimeter of the face plate has a semigloss surface with a chroma value of less than 4 and a lightness of at least 90. In at least some embodiments, the bright diffusely reflecting surface extends over at least 80% of the upward facing crown area. In other examples, the crown surface has a CIELab brightness of between 50 and 100, and a gloss value of less than 60 gloss units. In typical examples, the dark, diffusively reflecting face plate surface area has a CIELab brightness of less than 30 or 40, a chroma of less than 5 or 10, and a gloss value of less than 60 gloss units.

Putter heads comprise a crown having at least an upward facing surface portion provided with a white diffusing surface treatment as viewed from an address orientation. A central alignment index is situated on the crown and extends so as to be perpendicular to a striking surface, the central alignment index provided with a black diffusing surface treatment. At least one aperture is defined in a club body and situated behind the striking surface as viewed from the address orientation, wherein the aperture is symmetrically situated with respect to the central alignment index. In some examples, the white diffusing surface treatment has a gloss of less than 60 gloss units, and a CIE hue value that is between 250 degrees and 320 degrees. In other examples, the white diffusing surface treatment extends over at least 85% of the upward facing surface portion and the central alignment index comprises a groove extending to the striking surface and the black diffusing surface is situated within the groove. In additional examples, a dark striking surface is provided having a CIE L* values of less than 50.

In some embodiments the golf club heads have a body having a face, a crown and a sole together defining an interior cavity, the golf club body also includes a heel and a toe portion and a portion of the crown or a layer covering at least a portion of the crown of the golf club head is covered by a dielectric coating system.

BRIEF DESCRIPTION OF THE DRAWINGS

The patent or application file contains at least one drawing executed in color. Copies of this patent or patent application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee. The features and components of the following figures are illustrated to emphasize the general principles of the present disclosure.

Corresponding features and components throughout the figures may be designated by matching reference characters for the sake of consistency and clarity.

FIG. **1**A is a toe side view of a golf club head in accord with one embodiment of the current disclosure.

FIG. **1**B is a face side view of the golf club head of FIG. **1**A.

FIG. **1**C is perspective view of the golf club head of FIG. **1**A.

FIG. **1**D is a top view of the golf club head of FIG. **1**A.

FIG. **2** is a top view of a golf club head in accord with one embodiment of the current disclosure.

FIG. **3** is a top view of a golf club head in accord with one embodiment of the current disclosure.

FIG. **4** is a top view of a golf club head in accord with one embodiment of the current disclosure.

FIG. **5** is a top view of a golf club head in accord with one embodiment of the current disclosure.

FIG. **6** is a top view of a golf club head in accord with one embodiment of the current disclosure.

FIG. **7** is a top view of a golf club head in accord with one embodiment of the current disclosure.

FIG. **8**A is a front view of the apparatus used for measuring a Sight Adjusted Perceived Face Angle in accordance with the current disclosure.

FIG. **8**B is a close up view of the arrangement of the laser and cameras in the apparatus used for measuring a Sight Adjusted Perceived Face Angle in accordance with the current disclosure.

FIG. **8**C is a side view of a golf club head fixture in apparatus used for measuring a Sight Adjusted Perceived Face Angle in accordance with the current disclosure.

FIG. **9** is a graph of the Sight Adjusted Perceived Face Angle vs. the Dispersion in Ball Flight for four clubs having the alignment features in accordance with the current disclosure.

FIG. **10**A is a top view of a golf club head in accord with one embodiment of the current disclosure.

FIG. **10**B is a top view of a golf club head in accord with one embodiment of the current disclosure.

FIG. **11** is a reference to the CIELAB color system.

FIG. **12**A is a perspective view of a mallet-type high visibility putter, as viewed from the rear, one side.

FIG. **12**B is a top plan view of the putter head of FIG. **1**A.

FIG. **12**C is a bottom plan view of the putter head of FIG. **1**A.

FIG. **12**D is a front elevational view of the putter head of FIG. **1**A.

FIG. **12**E is a back elevational view of the putter head of FIG. **1**A.

FIG. **13**A is a top plan view of a one example of a high visibility putter head.

FIG. **13**B is a front elevational view of the putter head of FIG. **2**A.

FIG. **14**A is a front elevational view of a golf club head in accordance with one embodiment.

FIG. **14**B is a side elevational view of the golf club head of FIG. **3**A.

FIG. **14**C is a top plan view of the golf club head of FIG. **3**A.

FIG. **14**D is a side elevational view of the golf club head of FIG. **3**A.

FIG. **15**A is a view of a driver-type golf club head according to a representative embodiment.

FIG. **15**B is a view of a driver-type golf club head according to a representative embodiment.

FIG. **15**C is a view of a driver-type golf club head according to a representative embodiment.

FIG. **15**D is a view of a driver-type golf club head according to a representative embodiment.

FIG. **15**E is a view of a driver-type golf club head according to a representative embodiment.

FIG. **16** is a perspective view of a wood-type golf club as viewed from a top, one side, according to a representative embodiment.

FIG. **17** is a top plan view of a crown of a golf club head according to an additional embodiment.

FIG. **18** is a graph illustrating relative reflected intensity across a crown of a driver type golf club head for club heads with black glossy, black matte, and white matte finishes.

FIG. **19** is a top plan view of one embodiment of an iron type golf club head at normal address position.

FIG. **20**A illustrates a representative system for measuring club head surface reflectance for putter type clubs.

FIG. **20**B illustrates a representative system for measuring club head surface reflectance for metalwood type clubs.

FIG. **21** is graph illustrating measured crown surface brightness along a plurality of pixel radii spaced at 30 degrees for a conventional glossy black driver crown.

FIG. **22** illustrates selected equal intensity contours for the club head associated with FIG. **10** and further illustrating pixel radii along which surface brightness is graphed.

FIG. **23** is a graph illustrating measured crown surface brightness along a plurality of pixel radii spaced at 30 degrees for a matte black driver crown.

FIG. **24** illustrates selected equal intensity contours for the club head associated with FIG. **12**.

FIG. **25** is a graph illustrating measured crown surface brightness along a plurality of pixel radii spaced at 30 degrees for a contrast enhanced white driver crown.

FIG. **26** illustrates selected equal intensity contours for the club head associated with FIG. **14**.

FIG. **27** is a graph illustrating measured crown surface brightness along a plurality of pixel radii spaced at 30 degrees for a conventional non-black driver crown.

FIG. **28** is a graph illustrating measured crown surface brightness along a plurality of pixel radii spaced at 30 degrees for a non-black metal type fairway wood crown.

FIG. **29** is a graph illustrating measured crown surface brightness along a plurality of pixel radii spaced at 30 degrees for a polymer driver crown.

FIG. **30** illustrates selected equal intensity contours for the club head associated with FIG. **29**.

FIG. **31** is a graph illustrating measured top surface brightness along a plurality of pixel radii spaced at 30 degrees for another conventional driver.

FIG. **32** is a graph summarizing measured top surface brightness along a 0 degree radius for a plurality of club heads.

FIG. **33** is an elevational view of a representative contrast-enhanced wood-type club head.

FIG. **34** is a graph illustrating measured top surface brightness along pixel radii at 120 degrees and 270 degrees for a putter head having a matte clear coat over a metallic surface.

FIG. **35** is a graph illustrating measured top surface brightness along pixel radii at 120 degrees and 300 degrees for a putter head having a diffusing white top surface.

FIG. **36** illustrates selected equal intensity contours for the putter head associated with FIG. **35**.

FIG. **37** is a graph illustrating measured top surface brightness along pixel radii at 120 degrees and 300 degrees for a putter head having a diffusing white top surface.

FIG. **38** is a graph illustrating measured top surface brightness along pixel radii at 120 degrees and 270 degrees for a conventional putter head.

FIG. **39** illustrates selected equal intensity contours for the putter head associated with FIG. **29**.

FIG. **40** is a graph illustrating measured surface brightness along a radius at 270 degrees for a conventional putter head.

DETAILED DESCRIPTION

Disclosed are various golf clubs as well as golf club heads including alignment features along with associated methods, systems, devices, and various apparatus. It would be understood by one of skill in the art that the disclosed golf clubs and golf club heads are described in but a few exemplary embodiments among many. No particular terminology or description should be considered limiting on the disclosure or the scope of any claims issuing therefrom.

The sport of golf is fraught with many challenges. Enjoyment of the game is increased by addressing the need to hit the golf ball further, straighter, and with more skill. As one progresses in golfing ability, the ability to compete at golf becomes a source of enjoyment. However, one does not simply hit a golf ball straighter or further by mere desire. Like most things, skill is increased with practice—be it repetition or instruction—so that certain elements of the game become easier over time. But it may also be possible to improve one's level of play through technology.

Much technological progress in the past several decades of golf club design has emphasized the ability to hit the golf ball further. Some of these developments include increased coefficient of restitution (COR), larger golf club heads, lighter golf club heads, graphite shafts for faster club speed, and center of gravity manipulation to improve spin characteristics, among others. Other developments have addressed a golfer's variability from shot-to-shot, including larger golf club heads, higher moment of inertia (MOI), variable face thickness to increase COR for off-center shots, and more. Still further developments address a golfer's consistent miss-hits—of which the most common miss-hit is a slice—including flight control technology (FCT, such as loft and lie connection sleeves to adjust, inter alia, face angle), moveable weights, sliding weight technologies, and adjustable sole pieces (ASP). Such technologies aid golfers in fixing a consistent miss, such that a particular error can be addressed.

As such, modern technology has done much to improve the golfer's experience and to tailor the golf club to the needs of the particular player. However, some methods are more effective than others at achieving the desired playing results. For example, research suggests that—for a drive of about 280 yards—a 1° difference in face angle at impact may account for about 16 yards of lateral dispersion in the resultant shot. Similarly, for moveable weights, changes in balance of weight by 12 grams moving for about 50 mm may result in about 15 yards of lateral dispersion on the resultant shot. However, it is also understood that a change in lie angle of the golf club head affects the face angle, but at a much smaller degree. As such, simply by increasing lie angle by 1°, the face angle alignment of the golf club head may be adjusted by 0.1° open or closed. As such, for better players who are simply trying to tune their ball flight, adjusting lie angle may be much more finely tunable than adjusting face angle. However, for many golfers, slicing (a rightward-curving shot for a right-handed golfer, as understood in the art) is the primary miss, and correction of such shot is paramount to enjoyment of the game.

One of the major challenges in the game of golf involves the difference between perception and reality. Golf includes psychological challenges—as the player's confidence wanes, his or her ability to perform particular shots often wanes as well. Similarly, a player's perception of his or her own swing or game may be drastically different from the reality. Some technology may address the player's perception and help aid in understanding the misconceptions. For example, technology disclosed in U.S. Pat. No. 8,771,095 to Beach, et. al, entitled "CONTRAST-ENHANCED GOLF CLUB HEADS," filed Mar. 18, 2011, provides a player with a clearer understanding of his or her alignment than some of the preexisting art at the time, which may improve that player's ability to repeat his or her shots. However, it may be more helpful to provide those players a method to address the misconceptions and provide correction for them.

We have now surprisingly found that alignment features that includes all or a portion of the interface region between the areas of contrasting shade or color on the crown of the club head and the face of the club head and/or all or a portion of the interface region between areas of contrasting shade or color on different portions on the crown of the club head allows for improved performance in the resulting clubs by accounting for not only the actual alignment of the club head by the golfer during the shot but also as modified by the perceived alignment of the club head by the golfer. One example of a combination of contrasting colors or shades would be for example a black or metallic grey or silver color contrasting with white, but also included are other combinations which provide at a minimum a "just noticeable difference" to the human eye.

Although a "just noticeable difference" in terms of colors of a golf club head is to a degree somewhat subjective based on an individual's visual acuity, it can be quantified with reference to the CIELAB color system, a three dimensional system which defines a color space with respect to three channels or scales, one scale or axis for Luminance (lightness) (L) an "a" axis which extends from green (−a) to red (+a) and a "b" axis from blue (−b) to yellow (+b). This three dimensional axis is illustrated in FIG. **11**.

A color difference between two colors can then be quantified using the following formula;

$$\Delta E^*_{ab}=\sqrt{(L^*_2-L^*_1)^2+(a^*_2-a^*_1)+(b^*_2-b^*_1)^2|}$$

where

(L^*_1, a^*_1 and b^*_1) and (L^*_2, a^*_2 and b^*_2) represents two colors in the L,a,b space and where

$\Delta E^*_{ab}=2.3$ sets the threshold for the "just noticeable difference" under illuminant conditions using the reference illuminant D65 (similar to outside day lighting) as described in CIE 15.2-1986.

Thus, for the alignment features of the golf clubs of the present invention, a contrasting color difference, ΔE^*_{ab}, is greater than 2.3, preferably greater than 10, more preferably greater than 20, even more preferably greater than 40 and even more preferably greater than 60.

For general reference, a golf club head **100** is seen with reference to FIGS. **1A-1D**. One embodiment of a golf club head **100** is disclosed and described with reference to FIGS. **1A-1D**. As seen in FIG. **1A**, the golf club head **100** includes a face **110**, a crown **120**, a sole **130**, a skirt **140**, and a hosel **150**. Major portions of the golf club head **100** not including the face **110** are considered to be the golf club body for the purposes of this disclosure.

The metal wood club head **100** has a volume, typically measured in cubic-centimeters (cm^3), equal to the volumetric displacement of the club head **100**, assuming any apertures are sealed by a substantially planar surface. (See United States Golf Association "Procedure for Measuring the Club Head Size of Wood Clubs," Revision 1.0, Nov. 21, 2003). In other words, for a golf club head with one or more weight ports within the head, it is assumed that the weight ports are either not present or are "covered" by regular, imaginary surfaces, such that the club head volume is not affected by the presence or absence of ports. In several embodiments, a golf club head of the present application can be configured to have a head volume between about 110 cm^3 and about 600 cm^3. In more particular embodiments, the head volume is between about 250 cm^3 and about 500 cm^3. In yet more specific embodiments, the head volume is between about 300 cm^3 and about 500 cm^3, between 300 cm^3 and about 360 cm^3, between about 360 cm^3 and about 420 cm^3 or between about 420 cm^3 and about 500 cm^3.

In the case of a driver, the golf club head has a volume between approximately 300 cm^3 and approximately 460 ccm^3, and a total mass between approximately 145 g and approximately 245 g. In the case of a fairway wood, the golf club head **10** has a volume between approximately 100 cm^3 and approximately 250 cm^3, and a total mass between approximately 145 g and approximately 260 g. In the case of a utility or hybrid club the golf club head **10** has a volume between approximately 60 cm^3 and approximately 150 ccm^3, and a total mass between approximately 145 g and approximately 280 g.

A three dimensional reference coordinate system **200** is shown. An origin **205** of the coordinate system **200** is located at the center of the face (CF) of the golf club head **100**. See U.S.G.A. "Procedure for Measuring the Flexibility of a Golf Clubhead," Revision 2.0, Mar. 25, 2005, for the methodology to measure the center of the striking face of a golf club. The coordinate system **200** includes a z-axis **206**, a y-axis **207**, and an x-axis **208** (shown in FIG. **1**B). Each axis **206**,**207**,**208** is orthogonal to each other axis **206**,**207**, **208**. The x-axis **208** is tangential to the face **110** and parallel to a ground plane (GP). The golf club head **100** includes a leading edge **170** and a trailing edge **180**. For the purposes of this disclosure, the leading edge **170** is defined by a curve, the curve being defined by a series of forward most points, each forward most point being defined as the point on the golf club head **100** that is most forward as measured parallel to the y-axis **207** for any cross-section taken parallel to the plane formed by the y-axis **207** and the z-axis **206**. The face **110** may include grooves or score lines in various embodiments. In various embodiments, the leading edge **170** may also be the edge at which the curvature of the particular section of the golf club head departs substantially from the roll and bulge radii.

As seen with reference to FIG. **1**B, the x-axis **208** is parallel to the GP onto which the golf club head **100** may be properly soled-arranged so that the sole **130** is in contact with the GP in the desired arrangement of the golf club head **100**. The y-axis **207** is also parallel to the GP and is orthogonal to the x-axis **208**. The z-axis **206** is orthogonal to the x-axis **208**, the y-axis **207**, and the GP. The golf club head **100** includes a toe **185** and a heel **190**. The golf club head **100** includes a shaft axis (SA) defined along an axis of the hosel **150**. When assembled as a golf club, the golf club head **100** is connected to a golf club shaft (not shown). Typically, the golf club shaft is inserted into a shaft bore **245** defined in the hosel **150**. As such, the arrangement of the SA with respect to the golf club head **100** can define how the golf club head **100** is used. The SA is aligned at an angle **198** with respect to the GP. The angle **198** is known in the art as the lie angle (LA) of the golf club head **100**. A ground plane intersection point (GPIP) of the SA and the GP is shown for reference. In various embodiments, the GPIP may be used as a point of reference from which features of the golf club head **100** may be measured or referenced. As shown with reference to FIG. **1**A, the SA is located away from the origin

205 such that the SA does not directly intersect the origin or any of the axes 206,207,208 in the current embodiment. In various embodiments, the SA may be arranged to intersect at least one axis 206,207,208 and/or the origin 205. A z-axis ground plane intersection point 212 can be seen as the point that the z-axis intersects the GP. The top view seen in FIG. 1D shows another view of the golf club head 100. The shaft bore 245 can be seen defined in the hosel 150.

Referring back to FIG. 1A, a crown height 162 is shown and measured as the height from the GP to the highest point of the crown 120 as measured parallel to the z-axis 206. The golf club head 100 also has an effective face height 163 that is a height of the face 110 as measured parallel to the z-axis 206. The effective face height 163 measures from a highest point on the face 110 to a lowest point on the face 110 proximate the leading edge 170. A transition exists between the crown 120 and the face 110 such that the highest point on the face 110 may be slightly variant from one embodiment to another. In the current embodiment, the highest point on the face 110 and the lowest point on the face 110 are points at which the curvature of the face 110 deviates substantially from a roll radius. In some embodiments, the deviation characterizing such point may be a 10% change in the radius of curvature. In various embodiments, the effective face height 163 may be 2-7 mm less than the crown height 162. In various embodiments, the effective face height 163 may be 2-12 mm less than the crown height 162. An effective face position height 164 is a height from the GP to the lowest point on the face 110 as measured in the direction of the z-axis 206. In various embodiments, the effective face position height 164 may be 2-6 mm. In various embodiments, the effect face position height 164 may be 0-10 mm. A distance 177 of the golf club head 100 as measured in the direction of the y-axis 207 is seen as well with reference to FIG. 1A. The distance 177 is a measurement of the length from the leading edge 170 to the trailing edge 180. The distance 177 may be dependent on the loft of the golf club head in various embodiments.

For the sake of the disclosure, portions and references disclosed above will remain consistent through the various embodiments of the disclosure unless modified. One of skill in the art would understand that references pertaining to one embodiment may be included with the various other embodiments.

As seen with reference to FIG. 2, a golf club head 500 includes a painted crown 120 and unpainted face 110. Painted or otherwise contrast-enabled crowns have been utilized as described in U.S. Pat. No. 8,771,095 to Beach, et. al, entitled "CONTRAST-ENHANCED GOLF CLUB HEADS," filed Mar. 18, 2011, to provide golfers with aided alignment. Typically the golfer employs the crown to face transition or top-line to align the club with the desired direction of the target line. The top-line transition is clearly delineated by a masking line between the painted crown and the unpainted face. While such features may have been described to some degree, use of the features to bias alignment has not been conceived in the art. With the golf club head 500 of the current embodiment, one of skill in the art would understand that the high-contrast described in U.S. Pat. No. 8,771,095 to Beach, et. al, entitled "CONTRAST-ENHANCED GOLF CLUB HEADS," filed Mar. 18, 2011, may be beneficial for emphasizing various alignment features. As such, the disclosure is incorporated by reference herein in its entirety.

For reference, a face angle tangent 505 is seen in FIG. 2. The face angle tangent 505 indicates a tangent line to the center face 205. The face angle tangent 505 in the current embodiment is coincident with the x-axis 206 (as seen with reference to prior FIGS.). Also seen in FIG. 2 is a top tangent 510. In the current embodiment, the top tangent 510 is a line made tangent to a top of the face 110 because, in the current embodiment, a joint between the face 110 and the crown 120 is coincident with paint lines. The top tangent 510 in the several embodiments of the current disclosure will follow the contours of various paint lines of the crown 120, and one of skill in the art would understand that the top tangent 510 need not necessarily be coincident with a tangent to the face 110. However, in the current embodiment, the top tangent 510 is parallel to the face angle tangent 505. As such, the paint of the crown 120 can be described as appearing square with the face angle.

The purpose of highlighting such features of the golf club head 500 is to provide a basis for the discussion of alignment with respect to the current disclosure. Through variations in alignment patterns, it may be possible to influence the golfer such that the golfer alters his or her play because of the appearance of misalignment. If a player perceives that the golf club head is such that the face is open with reference to the intended target, he or she would be more likely to try to "square up" the face by manually closing it. Many golfers prefer not to perceive a metal wood golf club head as appearing closed, as such an appearance is difficult to correct. However, even if such a player were to perceive the metal wood head as being closed, such perception does not mean that the golf club head is aligned in a closed position relative to the intended target.

As seen with reference to FIG. 3, a golf club head 600 includes similar head geometries to golf club head 500. However, the golf club head 600 includes a feature to alter the perceived angle of the face 110 for the user. In the current embodiment, a top tangent 610 that is aligned at an angle 615 with respect to the face angle tangent 505 such that the perceived angle of the face (Perceived Face Angle, PFA) is different from the actual alignment of the face angle tangent 505. In the current embodiment, the angle 615 is about 4°. In various embodiments, the angle 615 may be 2°-6°. In various embodiments, the angle 615 may be less than 7°. In various embodiments, the angle 615 may be 5-10°. In various embodiments, the angle 615 may be less than 12°. In various embodiments, the angle 615 may be up to 15°. As indicated with respect to top tangent 510, the top tangent 610 is an indicator of the alignment of an edge of an area of contrasting paint or shading of the crown 120 delineated by a masking line between the painted crown and the unpainted face relative to the color or shading of the face 110 and is the line that is tangent to an edge 614 of the contrasting crown paint or crown shading at a point 612 where the edge 614 intersects a line parallel to the y-axis 207.

In various embodiments, a perceived angle may be determined by finding a linear best-fit line of various points. For such approximation, a perceived angle tangent may be determined by best fitting points on the edge 614 at coordinates of the x-axis 208 that are coincident with center face 205—point 612—and at points ±5 mm of CF 205 (points 622*a,b*), at points ±10 mm of CF 205 (points 624*a,b*), at points±15 mm of CF 205 (points 626*a,b*), and at points ±20 mm of CF 205 (points 628*a,b*). As such, nine points are defined along the edge 614 for best fit of the top tangent 610. In the current embodiment, the perceived angle tangent is the same as the top tangent 610.

However, such method for determining the perceived angle tangent may be most useful in cases where the edge 614 of an area of contrasting paint or shading of the crown 120 relative to the color or shading of the face 110 includes different radii of relief along the toe portion and the heel portion. In such an embodiment, a line that is tangent to the edge **614** at point **612** may not adequately represent the appearance of the alignment of the golf club head **600**. Such an example can be seen with reference to FIG. **4**.

As seen in FIG. **4**, a golf club head **700** includes an edge **714** of an area of contrasting paint or shading of the crown **120** relative to the color or shading of the face **110** that is more aggressively rounded proximate the toe **185** than prior embodiments. As such, a line **711** that is literally tangent to the edge **714** at a point **712** that is coincident with the y-axis **207** may not adequately describe the perception. Such a line would be the top tangent **710**. However as noted previously with reference to golf club head **600**, points **712**, **722***a,b*, **724***a,b*, **726***a,b*, and **728***a,b*, can be used to form a best fit line **730** that is aligned at a perceived angle **735** that is greater than an angle **715** of the top tangent **710**. In various embodiments, the perceived angle **735** may be within the increments of angle **615**, above, or may be up to 20° in various embodiments. In most embodiments, the perceived angle **735** may be 8-10°. In various embodiments, the perceived angle **735** may be 9-10°. In various embodiments, the perceived angle **735** may be 7-11°. In various embodiments, the perceived angle **735** may be 7-8.5°. In various embodiments, alignment may be influenced by the inclusion of an alignment feature that does not invoke an edge such as edges **614**, **714**. As seen with reference to FIG. **5**, various embodiments of alignment features may be suggestive of the face angle and, as such, provide an appearance of alignment to the golfer without modifying paint lines.

A golf club head **800**, as seen in FIG. **5**, includes an alignment feature **805**. The alignment feature **805** of the current embodiment includes at least one elongate side **807**—and in the current embodiment, two elongate sides **807***a* and **807***b* are included. The alignment feature **805** of the current embodiment also includes two additional sides **808***a* and **808***b*. As can be seen, the alignment feature **805** is arranged such that the at least one elongate side **807** is aligned about parallel to the x-axis. As such, a golfer is able to use the alignment feature **805** by aligning the direction of the elongate side **807** in an orientation that is about perpendicular to the intended target. The alignment feature **805** has a length **847** as measured parallel to the x-axis **208**. In the current embodiment, the length **847** is about the same as the diameter of a golf ball, or about 1.7 inches. However, in various embodiments, the length **847** may be 0.5 inches, 0.75 inches, 1 inch, 1.25 inches, 1.5 inches, 1.75 inches, 2 inches, 2.25 inches, 2.5 inches, or various lengths therein. If the length **847** of the dominant elongate side **807***a* or **807***b* is less than about 0.3 inches, the impact of the alignment feature **805** on biasing the golfer's perception decreases substantially.

However, with sufficient use, the alignment feature **805** can become the primary focus of the golfer's attention and, as such, modifications to the arrangement of the alignment feature **805** with respect to the x-axis **208** (which is coincident with the face angle tangent **505**) may allow the golfer to bias his or her shots and thereby modify his or her outcome.

As seen with reference to FIG. **6**, a golf club head **900** includes an alignment feature **905**. The alignment feature **905** of the current embodiment includes one elongate side **907***a* on a side of the alignment feature **905** that is proximate the face **110**. The alignment feature **905** includes several potential rear portions. Similar to golf club head **800**, golf club head **900** includes the alignment feature **905** having a potential second elongate side **907***b* in one embodiment. In another embodiment, an extended rear portion **907***c* may also be included or may be included separately from elongate side **907***b*. In the current embodiment, the elongate side **907***b* is oriented at an angle **915** with respect to the face angle tangent **505**.

For the embodiment including second elongate side **907***b*, the second elongate side **907***b* is about parallel to the elongate side **907***a*. As such, the embodiment is similar to golf club head **800** but is oriented at angle **915**. With respect to extended rear portion **907***c*, the orientation of such an embodiment may appear less askew and, consequently, may be more effective at modifying the golfer's perception of the club's alignment. A perpendicular reference line **918** is seen as a reference for being orthogonal to the elongate side **907***a*. The perpendicular reference line **918** intersects the elongate side **907***a* at a point **919** that bisects the elongate side **907***a*. Further, the perpendicular reference line **918** intersects the x-axis **208** at an intersection point **921** that is heelward of the center face **205**. In the current embodiment, the intersection point **921** is heelward of center face **205** by about 2 mm. In various embodiments, the intersection point **921** may be about the same as center face **205**. In various embodiments, the intersection point **921** may be up to 2 mm heelward of center face **205**. In various embodiments, the intersection point **921** may be up to 5 mm heelward of center face **205**. In various embodiments, the intersection point **921** may be somewhat toeward of center face **205**. In various embodiments, the intersection point **921** may be ±2 mm of the center face **205**.

Another embodiment of a golf club head **1100**, shown in FIG. **7**, includes an alignment feature **1105**. The alignment feature has a first elongate side **1107***a* and a second elongate side **1107***b*. In the current embodiment, however, the first elongate side **1107***a* is about parallel with the face angle tangent **505** and the x-axis **208**. However, the second elongate side **1107***b* is oriented at an angle **1115** with respect to the face angle tangent **505** such that the golfer's perception of alignment may be altered.

A preferred method for measuring the perceived face angle observed by a golfer further takes into account the fact that most golfers have a dominant left eye and when they address the ball with the club head, a direct line between the left eye and center face would actually cross the topline heel ward of center face and thus this is where an alignment feature which includes an edge of an area of contrasting paint or shading of the crown **120** relative to the color or shading of the face **110** would exert the most effect on the golfer's perception of the face angle. This perceived face angle is thus called a Sight Adjusted Perceived Face Angle (SAPFA) and is measured using the apparatus shown in FIGS. **8**A-**8**C.

The apparatus used is shown in FIGS. **8**A, **8**B and **8**C and includes a frame **1203** which holds a fixture **1205** for holding and aligning a golf club shaft **1207** and attached golf club head **1209** at a Lie Angle of 45°. The face of the golf club head **1209** is also set at a face angle of 0° using a face angle gauge **1211**. The face angle gauge may be any commonly used in the industry such as a De la Cruz face angle gauge). After setting the loft and lie angle the club is clamped in the fixture using a screw clamp **1213**. The frame **1203** also includes an attachment point **1215** for mounting two cameras **1217** and **1219** and a Calpac Laser CP-TIM-230-9-1L-635 (Fine/Precise Red Line Laser Diode Module Class II: 1 m W/635 nm), **1221**. The center of the lens of camera **1219** is situated at the x, y and z coordinates (namely 766 mm, 149 mm, 1411 mm) using the previously defined x y and z axes with USGA center face (as measured using the procedure in

U.S.G.A. "Procedure for Measuring the Flexibility of a Golf Clubhead," Revision 2.0, Mar. 25, 2005, "USGA Center Face") as the origin, and where a positive x coordinate represents a position heel ward of center face, a positive y coordinate represent a position rearward of center face and a positive z coordinate represents a position above center face. The laser is situated between the two cameras.

As shown in FIG. **8**C the laser produces a line **1223** having an axis parallel to the camera axis and projecting along the y axis which is adjusted such that the line intersects USGA Center Face **1225**. The point **1227** at which the line then intersects the edge of an area of contrasting paint or shading of the crown **120** relative to the color or shading of the face **110** which in this case corresponds to the white paint line of the crown **1229** is then physically marked on the paint line using a marker and acts a the datum or reference point. A camera is then activated to take an image of the club head including the datum or reference point **1227** and the paint line **1229**.

The image from the camera is then analyzed using an image analyzer software package (which can be any of these known in the art able to import an image and can fit a line to the image using a curve fitting function). A best fit line to the paint line is then determined. For most embodiments the best fit to the paint line results from fitting the line to a quadratic equation of the form $y=ax^2+bx+c$. Two points are then selected on this best fit line at arc length between +/−0.25 mm from the datum point. A straight line is then drawn between the two points and a line perpendicular to this line is then drawn through the datum. The Sight Adjusted Perceived Face Angle (SAPFA) is then measured as the angle between the perpendicular line and they axis.

Using this method the Sight Adjusted Perceived Face Angle (SAPFA) of the golf clubs of the present invention may be from −2 to 10, preferably from Oto **6**, more preferably from 0.5 to 4 even more preferably from 1 to 2.5 and most preferably from 1.5 to 2 degrees.

Examples

Four identical club heads were taken and the paint line edge of an area of contrasting paint or shading of the crown **120** relative to the color or shading of the face **110** was varied and the Sight Adjusted Perceived Face Angles (SAPFA) measured.

In addition to the Sight Adjusted Perceived Face Angles (SAPFA) four additional measurements were taken to describe the paint line edge alignment feature of the four clubs and these values are summarized in Table 1.

In addition to the SAPFA, three additional angles were measured at different points as measured from the datum along the best fit line to the paint line edge alignment feature determined as for the SAPFA. The first angle was obtained at a point along the best fit line at an arc length 25 mm heelward of the datum. Again as for the SAPFA measurement, two points at arc length between+/−0.25 mm from the 25 mm point were selected. A straight line is then drawn between these two points and a line perpendicular to this line is then drawn at the 25 mm point. The angle is then measured between this perpendicular line and they axis.

This angle is reported as the Sight Adjusted Perceived Face Angle 25 mm Heelward ("$SAPFA_{25H}$").

The second angle was obtained at a point along the best fit line at an arc length 25 mm toeward of the datum. Again as for the SAPFA measurement, two points at arc length between +/−0.25 mm from the 25 mm point were selected. A straight line is then drawn between the two points and a line perpendicular to this line is then drawn at the 25 mm point. The angle is then measured between this perpendicular line and the y axis. This angle is reported as the Sight Adjusted Perceived Face Angle 25 mm Toeward ("$SAPFA_{25T}$").

In addition, to capture any effect of greater rounding of the paint line edge alignment feature towards the toe of the golf club head, a third angle was obtained at a point along the best fit line at an arc length 50 mm toeward of the datum. Again as for the SAPFA measurement, two points at arc length between+/−0.25 mm from the 25 mm point were selected. A straight line is then drawn between the two points and a line perpendicular to this line is then drawn at the 50 mm point. The angle is then measured between this perpendicular line and the y axis. This angle is reported as the Sight Adjusted Perceived Face Angle 50 mm Toeward ("$SAPFA_{25H}$").

Finally, in an attempt to describe more of the paint line edge alignment feature, the image of the paint line edge alignment feature imported into the image analyzer as for the SAPFA measurement was also fit to a circle using the formula $(x-a)^2+(y-b)^2=r^2$, and the radius of curvature of this circular fit line determined and reported in Table I as the Radius of Curvature (circle fit).

TABLE 1

Example No.	Sight Adjusted Perceived Face Angle (SAPFA) (degrees)	Radius of Curvature (circle fit, mm)	Angle 25 mm Heelward (degrees)	Angle 25 mm Toeward (degrees)	Angle 50 mm Toeward (degrees)
1	3.5722	570.47	1.1377	5.9453	8.2757
2	5.2813	419.53	1.7509	8.6871	11.9168
3	0.2927	781.02	−1.4461	2.0189	3.7129
4	−0.5925	568.21	−3.06	1.8533	4.245

Each club was then hit between 6 to 12 times by 10 different players into a blank screen with no trajectory or other feedback available to the player, and a Trackman 3e launch monitor and the TPS software package were used to calculate the total dispersion from a center target line with a positive total dispersion indicating the number of yards right of the center target line and a negative total dispersion indicating the number of yards left of the center target line. Thus, a player who has a tendency to slice the ball i.e. produce a ball flight right of the target line would be assisted in producing a shot closer to the target line if the golf club tended to yield a more negative dispersion.

The graph in FIG. **9** plots the Sight Adjusted Perceived Face Angle (SAPFA) versus the average total dispersion of each club when hit 6-12 times by each player. The data show that adjustment of the edge of an area of contrasting paint or shading of the crown relative to the color or shading of the face such that the Sight Adjusted Perceived Face Angle (SAPFA) of the golf club goes from −0.88 degrees through 0.5 degrees through 3.34 degrees to 5.55 degrees results in an overall change in total dispersion from 8.6 yards to the right of the target line to 24.2 yards to the left of the target i.e. an absolute change in total dispersion of 32.8 yards from the same club head by solely manipulating the appearance of the paint line comprising the primary alignment feature.

The golf club heads of the present invention have a Sight Adjusted Perceived Face Angle (SAPFA) of from about −2 to about 10, preferably of from about 0 to about 6, more preferably of from about 0.5 to about 4 even more preferably of from about 1 to about 2.5 and most preferably of from about 1.5 to about 2 degrees.

The golf club heads of the present invention also have a Sight Adjusted Perceived Face Angle 25 mm Heelward ("$SAPFA_{25H}$") of from about −5 to about 2, more preferably of from about −3 to 0, even more preferably of from about −2 to about −1 degrees.

The golf club heads of the present invention also have a Sight Adjusted Perceived Face Angle 25 mm Toeward ("SAPFA2sT") of from Oto about 9, more preferably of from about 1 to about 4.5, even more preferably of from about 2 to about 4 degrees.

The golf club heads of the present invention also have a Sight Adjusted Perceived Face Angle 50 mm Toeward ("$SAPFA_{50T}$") of from about 2 to about 9, more preferably of from about 3.5 to about 8, even more preferably of from about 4 to about 7 degrees.

The golf club heads of the present invention also have a Radius of Curvature (circle fit) of from about 300 to about 1000, more preferably of from about 400 to about 900, even more preferably of from about 500 to about 775 mm.

In other embodiments, the golf club head in addition to having a first or primary alignment feature as described earlier with reference to FIGS. **1-4**, may also have a second or secondary alignment feature including the alignment features as described earlier with reference to FIGS. **5**, **6** and **7**.

In an especially preferred embodiment, shown in FIG. **10**A and FIG. **10**B, the golf club head **1400** of the present invention can have a crown **120** having a first crown portion **120***a* having a first color or shade and a second crown portion **120***b* having a second color or shade, and a primary alignment feature consisting of a an edge **1402** of an area of contrasting paint or shading of the first crown portion **120***a* relative to the color or shading of the face **110** as described earlier and illustrated, e.g. in FIGS. **3** and **4**. In addition the club head has a secondary alignment feature **1404** proximate the face but rearward of the primary alignment feature and delineated by a second paint or masking line which delineates the transition between the first crown portion **120***a* having an area of contrasting shade or color with the shade or color of the face **110**; and a second crown portion **120***b* having an area of contrasting shade or color with the shade or color of the first crown portion **120***a*. The secondary alignment feature a comprises an elongate side **1406** having a length of from about 0.5 inches to about 1.7 inches, and a second and third elongate side **1408***a* and **1408***b* extending back from the face and at an angle to elongate side **1406** and rearward of elongate side **1406**.

The Sight Adjusted Perceived Face Angle Secondary Alignment Feature, ("$SAPFA_{SA}F$") of the secondary alignment feature constituting elongate side **1406** and the second and third elongate sides **1408***a* and **1408***b* may be measured by importing the image of the club head obtained as per the measurement for the SAPFA. Points **1410***b* and **1410***a* are selected which are the innermost ends of the radii connecting lines **1408***b* and **1408** a with elongate side **1406** as shown in FIG. **10**B. A best fit quadratic line is then fit for the secondary alignment feature between point **1410** a and **1410***b* and then a datum **1412** is determined as the center point along the arc length of the best fit line, again as for the SAPFA measurement, two points at arc length between +/−0.25 mm from the datum were selected. A straight line is then drawn between these two points and a line perpendicular to this line is then drawn at the datum. The Sight Adjusted Perceived Face Angle Secondary Alignment Feature, ("$SAPFA_{SAF}$") is then measured as the angle between this perpendicular line and they axis.

In some embodiments, the golf club heads of the present invention also have a Sight Adjusted Perceived Face Angle Secondary Alignment Feature, ("$SAPFA_{SAF}$") of from about −2 to about 6, more preferably of from 0 to about 5, even more preferably of from about 1.5 to about 4 degrees.

The primary and secondary alignment features as described herein typically utilize paint lines which demark the edge of an area of contrasting paint, e.g. between first crown portion **120***a* and second crown portion **120***b*, or shading of the crown **120** relative to the color or shading of the face **110**. Preferably the contrasting colors are white in the crown area (e.g. first crown portion **120***a*) and black in the face area. Typically painting or shading of golf club heads is performed at the time of manufacture and thus are fixed for the lifetime of the club absent some additional painting performed after purchase by the owner. It would be highly advantageous if the profile of the alignment feature could be adjusted by the user using a simple method which would allow adjustment of the perceived face angle by the user in response to the golfer's observed ball direction tendency on any given day.

In some embodiments of the golf club heads of the present invention the crown **120** comprises a rotatable or otherwise movable portion, e.g. the first crown portion **120***a*, with one side of said portion including the edge of an area of contrasting paint or shading of the crown **120** relative to the color or shading of the face **110** or relative to the color or shading of the second crown portion **120***b* which can be rotated or moved sufficient to yield the desired Perceived Face Angle, PFA and/or Sight Adjusted Perceived Face Angle (SAPFA) and/or Sight Adjusted Perceived Face Angle Secondary Alignment Feature, ("$SAPFA_{SAF}$") to produce the desired ball flight. The movable portion of the crown is held in position by a fastening device such as a screw or bolt or other fastening means **1415** which is loosened to allow for rotation or movement and then subsequently tightened to fix the position of the crown **120** after adjustment.

In addition to a portion of the crown being movable other embodiments include a movable layer or cover on top of the crown with one side of said movable layer or cover including the edge of an area of contrasting paint or shading of the crown **120**, e.g. the first crown portion **120***a*, relative to the color or shading of the face **110** or relative to the color or shading of the second crown portion **120***b*, which can be rotated or moved sufficient to yield the desired Perceived Face Angle, PFA and/or Sight Adjusted Perceived Face Angle (SAPFA) and/or Sight Adjusted Perceived Face Angle Secondary Alignment Feature, ("$SAPFA_{SAF}$"). The movable portion of the layer or cover is again held in position by a fastening device such as a screw or bolt or other fastening means **1415** which is loosened to allow for rotation or movement and then subsequently tightened to fix the position of the movable layer or cover after adjustment.

In other embodiments a portion of the crown **120**, e.g. first crown portion **120***a*, second crown portion **120***b*, or both, may comprise electronic features, e.g. electronic graphic display **1440**, e.g. as illustrated in FIG. **10**A, which can be selectively activated to generate the required appearance including but not limited to light emitting diodes (LED), organic LED's (OLED), printed electronics with illumination devices, embedded electronics with illumination devices, electroluminescent devices, and so called quantum dots.

In other embodiments, a portion of the crown **120**, e.g. first crown portion **120***a*, second crown portion **120***b*, or both, may comprise a coating that alters its characteristics when exposed to external conditions including but not limited to thermochromic coatings, photochromic coatings, electrochromic coatings and paramagnetic paint.

In one preferred embodiment, illustrated, e.g. with regard to FIG. **10**A, at least a portion of the crown **120** of the golf club head, e.g. first crown portion **120***a*, second crown portion **120***b*, or both, or a layer covering at least a portion of the crown **120** of the golf club head, comprises an electronic graphic display **1440**. The display **1440** provides active color and graphic control for either the entire top portion of the crown **120** or layer covering at least a portion of the crown, e.g. first crown portion **120***a*, second crown portion **120***b*, or both. The display **1440** may be constructed from flexible organic light-emitting diodes (OLED) displays, e-ink technology, digital fabrics, or other known means of active electronic color and graphic display means. For example, an organic light emitting diode (OLED) (e.g., a light emitting polymer (LEP), and organic electro luminescence (OEL)) is a light-emitting diode (LED) whose emissive electroluminescent layer is composed of a film of organic compounds. The layer usually contains a polymer substance that allows suitable organic compounds to be deposited in rows and columns onto a carrier substrate such as the at least a portion of the crown of the golf club head or a layer covering at least a portion of the crown of the golf club head, by a simple "printing" process. The resulting matrix of pixels can emit light of different colors.

In some embodiments, the at least a portion of the crown **120** of the golf club head, e.g. first crown portion **120***a*, second crown portion **120***b*, or both, or a layer covering at least a portion of the crown of the golf club head is segmented into portions which may be controlled differently from each other. For example, one side of the alignment feature, e.g. second crown portion **120***b* or face **110**, has a static surface color and the other side, e.g. first crown portion **120***a* or crown **120**, a second contrasting surface color display capability, e.g. electronic graphic display **1440**.

The display **1440** is operatively connected to a microprocessor **1450** disposed in the golf club head (e.g., via wires). The microprocessor **1450** is further operatively connected to a data port **1460**, for example a universal serial bus (USB) port (e.g., via wires). The data port **1460** allows transfer and retrieval of data to and from the microprocessor **1450**. Data ports and data transfer protocols are well known to one of ordinary skill in the art. The data port **1460** (e.g. a USB port) may be disposed in the rearward area of the golf club head.

Data can be obtained from a variety of sources **1480**. In some embodiments, an Internet website **1484** is dedicated to support of the golf club head of the present invention. For example, the website **1484** may contain downloadable data and protocols (e.g., colors, color patterns, images, video content, logos, etc.) that can be uploaded into the microprocessor **1450** of the golf club head (via the data port **1460**, via a cable, via a computer **1482**). As an example, the website **1484** may have a gallery for choosing colors to be displayed, as well as patterns of the colors.

In some embodiments, data can be uploaded from other sources **1480**, for example DVDs, CDs, memory devices (e.g., flash memory) **1486**, and the like. Sources may also include cellular phones, smart phones, personal digital assistants (PDAs), digital vending kiosks **1488**, and the like. In some embodiments, the data can be uploaded and downloaded via other mechanisms, for example wired mechanisms **1490** or wirelessly **1495**, e.g. via a wireless mechanism **1465**. Such mechanisms may include Bluetooth™, infrared datalink (IrDa), Wi-Fi, UWB, and the like.

In some embodiments, as illustrated in FIG. **10**A, one or more control buttons **1470** are disposed on the golf club head allowing a user to manipulate the display **1440** as desired. The control buttons **1470** are operatively connected to the microprocessor **1450**. The microprocessor **1450** is configured to receive input signals from the control buttons **1470** and further send output commands to manipulate the display **1440**. The control buttons **1470** may be operatively connected to the display **1440** and/or the microprocessor **1450** via one or more wires.

The microprocessor **1450** and/or display **1440** are operatively connected to a power source, for example a battery **1472**. The battery **1472** may be rechargeable. In some embodiments, the battery **1472** comprises a control means **1474** for turning on and off the device. All wires and data ports **1460** and other electronic systems are adapted to sustain the impact forces incurred when a golfer hits a golf ball with the golf club head.

In other embodiments of the golf club heads of the present invention a method to accomplish user adjustably of the alignment feature would involve at least a portion of the crown **120** of the golf club head, e.g. first crown portion **120***a*, second crown portion **120***b*, or both, or a layer covering at least a portion of the crown of the golf club head being covered by a dielectric electroluminescent coating system using as one example the materials and methods as described in U.S. Pat. No. 6,926,972 by M. Jakobi et al., issuing on August 9, 2005 and assigned to the BASF Corporation, the entire contents of which are incorporated by reference herein. Using this technology an electric current (provided by a small battery, e.g. battery **1472**, fixed securely in the golf club head cavity) could be selectively employed to use electroluminescence to highlight (or eliminate) a particular color thereby adjusting the orientation of the primary or secondary alignment features described herein.

Now, with reference to FIGS. **12**A-**40**, typical examples are described below that include bright white diffusing top surfaces that are more readily perceived by a golfer. In addition, such top surfaces produce an appearance of increased size, promoting golfer confidence. By providing a contrasting club face, the face/crown interface that is used for club alignment becomes more visually apparent.

Examples of wood type and iron type golf clubs and club heads are provided below. In addition, examples of putters and putter heads are provided. For convenient description, standard golf illumination is defined herein as illumination associated with common outdoor playing conditions in natural lighting, i.e., full sun, partial sun, partial shade, full shade, and overcast conditions at times a few hours after sunrise and a few hours before sunset. Golf club and club head features are described with reference to a club head position at an address position, i.e., a customary position from which a golfer initiates a swing sequence. For convenience, if needed, directions are referenced to an address position for a right handed golfer addressing a right handed club. A rearward direction is a direction from a striking surface opposite an intended line of ball flight. An upward direction is a direction upward from a playing surface.

Metal wood clubs as described herein can have bare metallic striking or other surface. Textured surfaces can be provided with a texture finish such as a tumble finish or sand blasted finish. Coatings can be applied to striking faces, and a durable coating such as produced with plasma vapor deposition (PVD) or ion plating (IP) is preferred, as paint can chip after use and may cause spin degradation. Clubs can have titanium alloy (Ti) faces or steel alloy (Steel), or other faces. The range of ion plating finish colors available to coat these faces is limited. One face coating for Ti or steel (and more durable than some other colors) is a black IP finish. Crown paints are available in a large variety of colors.

With reference to FIGS. **12**A-**12**E, a putter includes a putter head **2102** and a shaft mounting bore **2104** provided in the putter head **2102** for attachment of a putter shaft. The putter head **2102** has a shape that can be referred to as a mallet type as the putter head **2102** has a substantial depth from a putter striking face **2106** to a backmost surface **2108**. This configuration permits the putter head **2102** to have a relatively larger putter head mass and a larger moment of inertia than so-called blade type putter heads. Another benefit of the putter head **2102** having a larger head would be to set the center of gravity location farther back for improved roll or launch performance upon impact with the ball. The putter head **2102** includes a series of alignment indices **2111**, **2112**, **2113** situated on a top or crown surface **2114** and extending substantially perpendicularly from about the putter striking face **2106** to a rear arc **2116**. The alignment index **2112** (the central alignment index) is substantially aligned with a geometrical center of a striking surface **2120** situated on the putter striking face **2106** of the putter head **2102**. In some examples, the striking face **2106** is provided with an insert **2120** that is secured to the putter head in a recess provided in the putter head **2102**.

The rear arc **2116** corresponds to a boundary between a first portion **2122** of the putter head **2102** having a full thickness, and a stepped down portion **2124**. The indices **2111**, **2112**, **2113** noted above promote visual alignment but occupy less that about 5%, 6%, 7%, 8%, or 10% of the surface area of the first portion **2122** which is typically covered with a white diffusively reflecting surface treatment. The stepped down portion includes a circular aperture **2126** having a radius that is between about 0.8 and 1.2 times a golf ball diameter, 0.9 and 1.1 times a golf ball diameter, or 0.95 and 1.05 times a golf ball diameter. Typically, the diameter of the aperture **2126** is selected to be approximately equal to a golf ball diameter. In some examples, a golf ball diameter is about 41.67 mm. In other examples, the aperture **2126** has a diameter of between about 20 mm and 75 mm, 30 mm and about 60 mm, 36 mm and about 44 mm, or 38 mm and about 41 mm. A partial cylindrical bore **2127** is situated about the aperture **2126** and can have a diameter that is between about 0.1 mm and 5 mm greater that the diameter of the aperture **2126**. The partial bore **2127** typically has a depth of between 0.1 mm and 5 mm. The aperture **2126** and the bore **2127** are generally circular, but other shapes can be used, but situated so as to be symmetric about the central alignment index **2112** to facilitate alignment of the club head. In addition, the rear arc **2116** is situated so as to be bisected by the central alignment index **2112**. The putter head **2102** also has a perimeter that is symmetric with respect to the central alignment index **2112**, but perimeter symmetry can be adjusted to provide apparent symmetry when the putter head **2102** is viewed in address position as shaft attachment or other putter features can provide apparent distortion. As shown in FIG. **12**C, a bottom portion of the putter head **2102** can have relief regions **2130**, **2131** that can have a different surface finish than other portions of the putter head.

Because putting (as well as other golf strokes) requires precise alignment, the putter head **2102** is provided with suitable surface treatments to promote visibility and alignment. In one example (and as shown in FIGS. **12**A-**12**E), the putter head **2102** is substantially provided with a diffusing, white surface treatment. Such a surface treatment provides superior visibility with respect to the common putting surface backgrounds with which a putter is used. With such a surface treatment, the putter head **2102** appears substantially brighter than a putting surface and putting surface color provides an additional contrast with respect to a neutral white surface. Not only does a diffusing white surface treatment provide superior visibility with respect to a putting surface, such a diffusing surface reduces or eliminates specular reflections of the sun that are responsible for glare or bright spots experienced by a golfer when using a putter. The combination of increased apparent brightness of a putter head due to white surface treatment and diminished specular reflectance due to the diffusing surface substantially reduces distracting glare.

A diffused surface treatment is defined as a surface treatment applied to a club head base material to change the color or glossiness of the surface so as to control, reduce, or minimize any glare spots located on the crown of the golf club head. Diffused surface treatments include coatings located on top of the base material of the club head. In some embodiments, the diffuse surface treatment is a white color. Examples of diffuse surface treatments include paints, matte clear coats, clear coats, powder coatings, PVD, CVD, platings, ion platings, electroplatings, ceramic coatings. Examples of paints include urethane base coatings, pearl coats, epoxy based coatings, decals, inks, and primer coatings.

While providing a diffusing white surface for a putter head top surface is beneficial, such a surface is preferably used in conjunction with alignment indices that are provided with a surface treatment that establishes a dark, highly diffusing surface. In one embodiment, the putter can include a first primer layer being 50 μm thick, a second paint layer being about 85 μm thick, and a clear coat being about 115 μm thick. In one embodiment, the clear coat layer is thicker than the other individual layers. For example, a glossy black surface treatment tends to exacerbate visibility problems when used with a light colored top surface, because the absence (or reduction) in glare elsewhere on the top surface causes attention to be undesirably brought to specular reflections associated with alignment indices such as the alignment indices **2111**, **2112**, **2113**. Thus, a white or neutral diffusing top surface is preferably accompanied with a diffusing surface treatment for alignment indices.

The putter head **2102** of FIGS. **12**A-**12**E includes a plurality of alignment features that aid in alignment in addition to an enhanced contrast top surface and alignment indices with reduced specular reflectance. The aperture **2126** (and the partial bore **2127**), alignment indices **2111**, **2112**, **2113**, the rear arc **2116**, as well as the overall shape of the putter head are configured so that the golfer receives numerous apparent visual cues as to putter head alignment. In other examples, at least some of these features are omitted to provide greater design flexibility.

Surface treatments can be provided by applying a diffusing white paint to a club head, typically over a gray or other non-white primer coat. Alignment indices can be formed as grooves in the putter head **2102** that are then partially filed with a black diffusing material such as a flat black paint. Because the putter striking face **2106** is not visible (or barely visible) to a golfer, the striking face **2106** can be configured as desired. Alternatively, the surfaces of the striking face can be partially or completely treated as indicated above. In addition, putter faces can be visible based on the degree loft in the putter head. In preferred embodiments, the face has a high contrast to the remaining club color for alignment purposes. In one embodiment, the face is a black or dark color aiding in alignment while also minimizing the amount of color reflection created on the ball at the address position.

An alternative putter head **2202** is illustrated in FIGS. **13**A-**13**B. The putter head **2202** is a modified blade-type design that includes a blade **2204** that includes a striking surface **2206** and a rear surface **2208**. The blade **2204** extends upwardly from a sole **2210** that is provided with an alignment index **2212** that extends from a rear surface of the sole **2210** to the rear surface **2208** of the blade **2204**. An insert **2214** is provided in the striking surface **2206** to provide a striking area. The alignment index **2212** is generally aligned perpendicular to and centered on the striking surface. Shoulders **2220**, **2221** extend upwardly from the sole **2210** and are coupled to or unitary with the blade **2204**, and permit mass to be distributed away from the center of the striking surface so as to increase moment of inertia. The shoulders **2220**, **2221** can be made of a more dense material than other portions of the putter head **2202**, or can be provided with bores or other relieved volumes configured to receive additional weights. Inner surfaces **2222**, **2223** of the shoulders **2220**, **2221** are generally situated so as to provide a separation corresponding to a golf ball diameter. Typically, the separation is between about 0.8 and 1.2 times a golf ball diameter, 0.9 and 1.1 times a golf ball diameter, or 0.95 and 1.05 times a golf ball diameter. In some examples, a golf ball diameter is about 41.67 mm. In other examples, the separation is between about 30 mm and 75 mm, about 35 mm and about 60 mm, about 36 mm and about 44 mm, or about 38 mm and about 41 mm. To promote alignment and visibility, at least some portions of the putter body **2202** are provided with a suitable surface appearance. For example, upward facing portions of the putter head **2202** can be provided with a diffuse, white appearing coating or other surface treatment as described above. In addition, the alignment index **2212** can be provided with a dark, diffusing coating.

As used herein, a white reflecting surface is a surface that reflects at least about 50%, 60%, 70%, 80%, 85%, 90%, 95%, or 97% of an incident light flux corresponding to full sun, partial sun, partial shade, or shade daylight conditions or daylight cloud cover conditions. Such reflectances are such that the apparent color of the resulting reflected light is not appreciably different from that of the incident light flux. Reflectance for colored surfaces can be similarly defined. For example, a red surface is a surface that that reflects at least about 50%, 60%, 70%, 80%, or 85% of a red portion of incident light flux corresponding to full sun, partial sun, partial shade, shade daylight conditions, or daylight cloud cover conditions. An effective diffusing surface as used herein is a surface for which a ratio of luminous intensity produced by the diffusing surface with respect to a luminous intensity of a perfect (Lambertian) diffuser in response to illumination at normal incidence to the diffusing surface is at least 0.2, 0.4, 0.6, 0.8, or 0.9 at an angle of 20 degrees, 30 degrees, 40 degrees, or 45 degrees. As used herein, effective diffusing surfaces can be characterized with an effective diffusing ratio corresponding to the above ratios and a related diffusing angle. Contrasting surfaces can be provided based on total reflectance of less than 20%, 10%, or 5% of an incident light flux corresponding to full sun, partial sun, partial shade, shaded, or daylight cloud cover conditions.

While white appearing surface treatments can provide the greatest reflectances, off-white, eggshell white, and red, green, yellow, or other colors or tinted whites can be used. In some cases, whites corresponding to golf ball appearances are used, and can include brightening agents. In some examples, color contrast can be provided between club head features and a playing surface to increase contrast, but the examples below are described with reference to white or other almost color neutral surface treatments. For example, red surface portions can be contrasted with cyan surface portions, green surface portions with magenta surface portions, and blue surface portion with yellow surface portions, but other color combinations can be used. In addition, while selected portions of a club head can be provided with a selected contrast enhancing (or specular reflection reducing) surface treatment, such treatments can be provided as solid treatments that cover an entire surface portion, or stippling or patterns such as checks, stripes, or other periodic or aperiodic arrangements. Finally, neutral grays or darker colors can be used in which reflectances are less than those listed above. In some examples, only surface areas at or near selected club head edges are provided with white or other contrast enhancing or diffusing surface treatments.

Other types of golf clubs can be configured similarly. Referring to FIGS. **14**A-**14**D, characteristics of wood type golf clubs such as drivers, fairway woods, and rescues are shown by way of reference to a golf club head **2300** having a removable shaft **2050**. The club head **2300** comprises a centerface, or striking face, **2310**, scorelines **2320**, a hosel **2330** having a hosel opening **2340**, and a sole **2350**. The hosel **2330** has a hosel longitudinal axis **2060** and the shaft **2050** has a shaft longitudinal axis. In the illustrated embodiment, the ideal impact location **2312** of the golf club head **2300** is disposed at the geometric center of the striking surface **2310** (see FIG. **14**A). The ideal impact location **2312** is typically defined as the intersection of the midpoints of a height (H_{ss}) and width (W_{ss}) of the striking surface **2310**.

As shown in FIG. **14**A, a lie angle **2010** (also referred to as the "scoreline lie angle") is defined as the angle between the hosel longitudinal axis **2060** and a playing surface **2070** when the club is in the grounded address position. The grounded address position is defined as the resting position of the head on the playing surface when the shaft is supported at the grip (free to rotate about its axis) and the shaft is held at an angle to the ground such that the scorelines **2320** are horizontal (if the club does not have scorelines, then the lie shall be set at 60-degrees). The centerface target line vector is defined as a horizontal vector which is perpendicular to the shaft when the club is in the address position and points outward from the centerface point. The target line plane is defined as a vertical plane which contains the centerface target line vector. The square face address position is defined as the head position when the sole is lifted off the ground, and the shaft is held (both positionally and rotationally) such that the scorelines are horizontal and the centerface normal vector completely lies in the target line plane (if the head has no scorelines, then the shaft shall be held at 60-degrees relative to ground and then the head rotated about the shaft axis until the centerface normal vector completely lies in the target line plane).

The actual, or measured, lie angle can be defined as the angle **2010** between the hosel longitudinal axis **2060** and the playing surface **2070**, whether or not the club is held in the grounded address position with the scorelines horizontal. Studies have shown that most golfers address the ball with actual lie angle that is 10 to 20 degrees less than the intended scoreline lie angle **2010** of the club. Studies have also shown that for most golfers the actual lie angle at impact is between 0 and 10 degrees less than the intended scoreline lie angle **2010** of the club.

As shown in FIG. **14**B, a loft angle **2020** of the club head (referred to as "square loft") is defined as the angle between the centerface normal vector and the ground plane when the head is in the square face address position. As shown in FIG.

14D, a hosel loft angle **2072** is defined as the angle between the hosel longitudinal axis **2060** projected onto the target line plane and a plane **2074** that is tangent to the center of the centerface. The shaft loft angle is the angle between plane **2074** and the longitudinal axis of the shaft **2050** projected onto the target line plane. The "grounded loft" **2080** of the club head is the vertical angle of the centerface normal vector when the club is in the grounded address position (i.e., when the sole **2350** is resting on the ground), or stated differently, the angle between the plane **2074** of the centerface and a vertical plane when the club is in the grounded address position.

As shown in FIG. **14**C, a face angle **2030** is defined by the horizontal component of the centerface normal vector and a vertical plane ("target line plane") that is normal to the vertical plane which contains the shaft longitudinal axis when the shaft **2050** is in the correct lie (i.e., typically 60 degrees+/−5 degrees) and the sole **2350** is resting on the playing surface **2070** (the club is in the grounded address position).

The lie angle **2010** and/or the shaft loft can be modified by adjusting the position of the shaft **2050** relative to the club head. Adjusting the position of the shaft can be accomplished by bending the shaft and the hosel relative to the club head. As shown in FIG. **14**A, the lie angle **2010** can be increased by bending the shaft and the hosel inward toward the club head **2300**, as depicted by shaft longitudinal axis **2064**. The lie angle **2010** can be decreased by bending the shaft and the hosel outward from the club head **2300**, as depicted by shaft longitudinal axis **2062**. As shown in FIG. **14**C, bending the shaft and the hosel forward toward the striking face **2310**, as depicted by shaft longitudinal axis **2066**, increases the shaft loft. Bending the shaft and the hosel rearward toward the rear of the club head, as depicted by shaft longitudinal axis **2068**, decreases the shaft loft. It should be noted that in a conventional club the shaft loft typically is the same as the hosel loft because both the shaft and the hosel are bent relative to the club head. In certain embodiments disclosed herein, the position of the shaft can be adjusted relative to the hosel to adjust shaft loft. In such cases, the shaft loft of the club is adjusted while the hosel loft is unchanged. Such clubs are described in US Patent Application Publication 2010/0197424, which is incorporated herein by reference.

Adjusting the shaft loft is effective to adjust the square loft of the club by the same amount. Similarly, when shaft loft is adjusted and the club head is placed in the address position, the face angle of the club head increases or decreases in proportion to the change in shaft loft. In some embodiments, the face angle and the loft are decoupled from one another by an adjustable sole plate. Hence, shaft loft is adjusted to effect changes in square loft and face angle. In addition, the shaft and the hosel can be bent to adjust the lie angle and the shaft loft (and therefore the square loft and the face angle) by bending the shaft and the hosel in a first direction inward or outward relative to the club head to adjust the lie angle and in a second direction forward or rearward relative to the club head to adjust the shaft loft. Adjustable soles are described in further detail in U.S. patent application Ser. No. 12/646,769, filed Dec. 23, 2009, which is incorporated herein by reference.

While the mechanical adjustments described about with reference to a wood-type golf club permit precise adjustment, the effectiveness of these adjustments can be limited by a golfer's ability to appropriately address and strike a golf ball. To aid in club placement, a club crown area **2325** can be provided with a surface treatment so as to contrast with the club face **2310**. For example, the crown area **2325** can be made so as to have a white, diffusing appearance and the club face **2310** configured to appear black or otherwise dark. In this way the crown **2325** contrasts with the playing surface **2070** and the club face **2310**.

Representative examples of a driver-type club provided with contrast enhancement are shown in FIGS. **15**A-**15**E and FIG. **16**. Referring to FIGS. **15**A-**15**E, a club head **2402** includes a striking face **2404**, a sole **2406**, and a crown **2408**. The crown **2408** is shown as stippled to denote a white appearing surface that provides substantial diffusion to incident light. The striking face **2404** is provided with a dark diffusing surface to aid visibility. In an example shown in FIG. **16**, a club head **2502** includes a bright crown **2508** and a striking surface **2504** that includes portions **2510**, **2512**, either of which can be configured to contrast with the bright crown **2508**. For example, the portion **2512** or the portion **2510** can be provided with a white diffusing surface treatment or a dark diffusing surface treatment. One additional advantage that can be realized with a bright or white crown is that such surface treatments can make a club head appear larger, and improve player confidence.

While providing bright diffusing areas and contrasting dark areas facilitates golfer perception of a golf club, clubs such as drivers, fairway woods, and utility clubs ("wood-style clubs") do not typically include the substantial number of alignment aids that are available on putter heads such as shown in FIGS. **12**A-**12**B. Alignment of wood-style clubs is especially important because if the striking surface is not properly aligned at impact, then the landing position of the ball will be farther off-line than shots with irons or a putter with equivalent impact misalignments. For example, if a driver is misaligned so as to be 2 degrees open at impact, the struck ball will end up about 24 yards off-line relative to the intended path, assuming an initial ball speed of 145 mph. Similarly, if a 6-iron is 2 degrees open relative at impact, the struck ball will end up about 13 yards off-line, and a wedge at 2 degrees open would be 2 yards off-line. In order to return the club to square at impact, the club face is preferably precisely aligned at address, prior to impact. For most golfers, a repeatable swing is difficult to achieve, and without a repeatable address alignment, even a repeatable swing will not produce repeatable results.

With regards to putters, studies have shown that on a 12-foot putt, only 35% of shots are aimed inside the cup at address, meaning 65% are aimed outside the cup. The tolerance for being inside the cup at 12 feet is ±0.85 degrees.

The two primary cues for aligning a metal wood type club at address are typically the crown/face masking line and the scorelines. Referring again to FIG. **15**B, for the representative driver club head **2402**, a crown/face ball flight axis **2455** extends forward and perpendicular to a crown/face masking line **2450** and an scoreline ball flight axis **2460** extends forward and perpendicular to scorelines **2451** on the striking face. As shown in FIG. **15**B, the axes **2455**, **2460** do not point in the same direction. Typically, a scoreline-based axis such as the axis **2460** appears to point a few degrees to the left of a crown/face based axis such as the axis **2455**. Crown/face masking lines associated with bright or white crowns such as those of FIGS. **15**A-**16** are more readily apparent to the golfer. Because the crown/face masking lines are more visible, golfers tend to rely more on the associated axis to align the club head, and tend to disregard scoreline-based alignment axes. In some examples, a durable bright white diffusing surface treatment is applied to a crown and a durable black (IP) surface treatment is applied to a striking face. It is further desirable to suitably configure scorelines to provide adequate contrast but not so much as to detract from the use of the crown/face line for club head alignment. Thus, scorelines are preferably not bright white to provide maximum contrast with respect to a black striking face, but instead are an intermediate gray so as not to confuse alignment.

While a white or reflective crown promotes more accurate alignment of a club head with respect to an intended line of flight, the visually larger club head tends to result in shots struck somewhat above the striking face center. To assist in more centered ball striking, scorelines (such as the scorelines **2451** of FIG. **15**B) can be moved down the striking face with respect to the club face center, typically by no more than about 0.5 mm, 1.0 mm, 2 mm, or 3 mm.

While providing a substantial upward facing portion of a golf club crown with a white or other bright surface treatment can provide substantial increases in visibility, such treatments can also be provided on selected portions of a crown. Referring to FIG. **17**, a club head **2602** includes a face **2606** and a crown having a central portion **2608** and a perimeter portion **2610**. The perimeter portion **2610** is preferably provided with a white diffusing surface treatment, while the inner portion **2608** can have a different surface treatment. In other examples, only a portion of the crown **2602** at face/crown interface **2614** is provided with a white or bright contrasting surface treatment, as this portion serves as a significant alignment aid.

FIG. **18** is a graph of relative reflected light intensity from a golf club head crown as a function of position for three different surface treatments. Data were obtained by evaluating digital photographs obtained under similar lighting conditions. Curves **2702** and **2704** correspond to glossy and matte black surfaces, respectively, and curve **2706** corresponds to a white matte surface. The relatively intensities associated with the curve **2706** are based on a digital photograph at an effective shutter speed that was twice that used to obtain data for the curves **2702**, **2704**. The curve **2706** shows that the reflected light intensity for a white surface is substantially greater than that of the glossy or matte black dark surfaces associated with the curves **2702**, **2704**, and the intensity is varies by less than about 20% over the crown, while both dark surfaces have much narrower distributions that vary at least 90% over the same area.

Iron-type clubs can also be provided with visibility enhancements based on diffusely reflecting surfaces. FIG. **19** is a top plan view of one embodiment of an iron type golf club head **2800** at normal address position. The club head **2800** is a unitary club head that includes a hosel **2802** and a striking face **2804**. At normal address position, the club head **2800** rests on a ground plane that is parallel to the ground. In this "normal address position" a vector normal to the striking face **2804** lies in a first vertical plane **2808** (i.e., a vertical plane that is perpendicular to the ground plane), a centerline axis **2810** of the club shaft lies in a second vertical plane, and the first vertical plane **2108** and the second vertical plane perpendicularly intersect.

To aid alignment of the club head **2800** and to provide the club head **2800** with a larger appearance, the striking face **2804** can be provided with white, off-white, eggshell-white or other surface treatments. Selected portions of the striking surface or the entire striking surface can be provided with such a treatment. The top line **2806** can have a similar surface treatment. However, referring to FIG. **19**, it is apparent that edges **2813**, **2814** of the top line **2806** are generally not perpendicular to an expected line of flight that is perpendicular to the striking surface. Thus, white surface treatment of the top line **2806** may be combined with enhanced visibility scorelines (or an enhanced visibility portion of the striking face) to provide alignment aids for the golfer. As shown in FIG. **19**, a portion **2816** of the striking face **2804** is provided with a white contrast enhancing surface treatment.

Representative Embodiments

In the following description of embodiments, some club head surfaces are described with reference to surface gloss. Smooth, polished surfaces generally exhibit a high gloss, and directly reflect light received, and depending on surface curvatures, can form one or more magnified, demagnified, real, or virtual images. Rough surfaces scatter light diffusely, and generally do not form clear images as do smooth surfaces. Surface gloss can be characterized by illuminating a surface at a specific angle, and measuring light intensity received in a range of reflection angles. Gloss measurements can be made with reference to the amount of light reflected from a black glass standard having a specified refractive index. In this way, gloss measurements can be established without direct reference to input light intensity. Standard gloss measurement geometries are specified for three gloss ranges: semigloss for surface glosses between 10 and 70 gloss units measured with a standard 60 degree geometry, high gloss for surface glosses greater than 70 gloss units measured with a standard 20 degree geometry, and low gloss for surface glosses that are less than 10 gloss units measured with a standard 80 degree geometry.

In some disclosed examples, surface gloss is referred to as semigloss or low gloss. As used herein, semigloss refers to a range of 10 to 70 gloss units measured with respect to a standard 60 degree geometry. However, some examples include semigloss surfaces having surface gloss in ranges having lower limits of 10, 20, 30, 40, 50, or 60 gloss units and upper limits of 20, 30, 40, 50, 60, or 70 gloss units. Similarly, low gloss surfaces include surfaces associated with standard gloss values of less than 10, 8, 5, 4, or 2 gloss units. Semigloss surfaces are typically preferred due to a chalky appearance that can be associated with low gloss surfaces. Gloss measurements can be conveniently made with portable glossmeters such as the MICRO-TRI-GLOSS meters from BYK Additives and Instruments.

Examples are also described, for convenience, with respect to CIELab color space using L*a*b* color values or L*C*h color values, but other color descriptions can be used. As used herein, L* is referred to as lightness, a* and b* are referred to as chromaticity coordinates, C* is referred to as chroma, and h is referred to as hue. In the CIELab color space, +a* is a red direction, −a* is a green direction, +b* is a yellow direction, and −b* is the blue direction. L* has a value of 100 for a perfect white diffuser. Chroma and hue are polar coordinates associated with a* and b*, wherein chroma (C*) is a distance from the axis along which a*=b*=0 and hue is an angle measured counterclockwise from the +a* axis. The following description is generally based on values associated with standard illuminant D65 at 10 degrees. This illuminant is similar to outside daylight lighting, but other illuminants can be used as well, if desired, and tabulated data provided herein generally includes values for illuminant A at 10 degrees and illuminant F2 at 10 degree. These illuminants are noted in tabulated data simply as D, A, and F for convenience. The terms brightness and intensity are also used in the following description to refer to CIELab coordinate L*.

Club Head Intensity Profiling

Some disclosed examples are described with respect to "hot spots" or other optical intensity profiles that are apparent on a wood-type club head crown, or a top surface of any club type with the club in a standard address position. Hot spots are visually distracting, and tend to promote club head misalignment or reduce golfer confidence in club head alignment. Suitable methods are described for reducing or eliminating such hot spots, typically so as to produce substantial areas of uniform visual intensity as viewed by a player with a club in a normal address position. As used herein, a "light diffusing region" of a club head refers to a portion of a club head surface over which reflected/diffused light intensity directed to a golfer with the golf club in a normal address position is at least 20%, 30%, 40%, 50%, 60%, 70%, 80%, or 90% of a maximum intensity of such reflected or diffused light. To promote accurate club head alignment without the visual impairment and distraction associated with hot spots, such diffusing regions can occupy substantial portions of an upward facing club head surface. A representative method for determining such light diffusing regions used in characterizing some embodiments is described below.

Referring to FIG. **20**A, a club or club head **2902** is situated on a flat surface (typically a work surface such as a table top or floor) with a club crown **2904** or other club top surface facing a light source **2906** such as a FEIT Electric 15 W compact fluorescent lamp (CFL) having an A-type bulb and emitting light with a color temperature of 2700 K. The club head **2902** is adjusted so that a hot spot or center of specular reflection or diffuse reflection from the crown **2904** or club top surface appears near the center of the surface. The crown **2904** can be imaged with a digital SLR camera **908** such as a CANON EOS REBEL XTi with an f/5.6 zoom lens set to have a focal length of between 56 and 64 mm. Image resolution of 1936 (w)×1288 (h) pixels is convenient. Shutter speed can be varied based on the intensity of light received from the club head to avoid detector saturation as described below. Images can be captured in an sRGB color format. The camera is secured to a tripod, and the camera, club head, and light source is enclosed in a black light tent to reduce the effects of light from sources other than the light source **906**.

For a putter type club, the arrangement of FIG. **20**A is used and the light source **2906** is situated so as to provide an illumination distance of about 27 inches from the club along an axis **2912**, and the club head surface is situated about 23 inches from the camera sensor along an axis **2914**. The light source **2906** and the camera sensor **2908** are separated by a distance **2916** of about 24 inches.

FIG. **20**B illustrates a second test setup for metalwood club heads where the light source **2906** is positioned virtually directly over the club head **2902**. The light source **2906** is situated so as to provide an illumination distance of about 22 inches from the club along an axis **2918**, and the club head surface is situated about 27 inches from the camera sensor along an axis **2922**. The light source **2906** and the camera sensor **2908** are separated by a distance **2920** of about 18 inches.

Image data from the camera **2908** is provided to a computer system **2918** or other processing system for analysis using MATLAB mathematical analysis software, but other processing systems and software can be used.

Exposures are set by adjusting image intensity so that maximum pixel intensity value is non-saturated and within a range of greater than 90% and less than 100% of maximum intensity value for the camera sensor. The camera **2908** can be set to provide RGB values in a range of 0 to 255. A saturated pixel would have pixel values (255, 255, 255) while a non-saturated pixel would have values of, for example, (254, 254, 254). Intensity is computed as a weighted sum 0.2989*R+0.5870*G+0.1140*B based on R, G, B values provided by the camera **2908** using MATLAB's rgb2gray function which converts image data to to HSV color space, and produces "V" values or luminance values which are referred to herein as intensities. Pixel intensities can be deemed acceptable when peak pixel intensity is greater than 229.5 and less than 255. To obtain suitable image intensities, images can be obtained using auto focus and averaging metering mode, and the shutter speed set for Exposure Value (EV) 0. An image is then obtained, and camera histogram mode used to identify saturation. If any saturated pixels are detected, the shutter speed can be doubled (i.e. the exposure time halved), and a new image acquired. This process can be repeated as needed. Even after saturation is eliminated, additional images could be acquired at a faster shutter speed to confirm that saturation has been eliminated.

Intensity images can be evaluated by selecting a pixel having a maximum intensity and establishing an image radius that is the longest radius that can be extended from the maximum intensity pixel to the image border. A pixel radius can be defined as a horizontal distance from the crown location associated with the maximum intensity pixel to an edge of the crown surface along an image radius. For convenience, this distance can also be referred to as an effective plan radius (EPR) as this distance is associated with an apparent crown extent as shown in a plan view of a club head (i.e., looking downward with the club in standard address position). In certain embodiments, a crown effective length can be defined as a length of a longest of a plurality of pixel radii from the brightest intensity location to the edge of a crown surface. In other embodiments, an effective crown region or zone can be defined as being a region of the crown surface that contains the longest pixel radius and the surface area between the longest pixel radius and the two adjacent pixel radii at angles of ±30 degrees with respect to the longest pixel radius so as to form a "slice" or triangular area wherein a secondary location on the crown a distance of at least 50% at any given pixel radius within the effective crown region is associated with an reflected intensity that is at least 20%, 30%, 40% or 50% of the highest reflected intensity. In other words, a zone of crown intensity is defined from the crown effective length in a direction of 30 degrees and negative 30 degrees from the crown effective length orientation, the zone of crown intensity being greater that at least 20%, 30%, 40% or 50% of the highest reflected intensity

Intensity values can be scaled by dividing by 255 to be positive and less than 1. Point values along lines at angles of 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, and 330 degrees extending from the maximum value pixel a distance of the image radius are obtained by interpolation of pixel values. These point values can be plotted to characterize a light diffusing region or to locate undesirable hot spots. Unless stated otherwise, image intensities were obtained in this manner for the examples described below. It will be appreciated that an image radius established in this manner generally extends beyond a club head surface. A crown effective length can be defined as a longest distance from the crown location associated with the maximum intensity pixel to a crown perimeter along which a light intensity is measured. In other embodiments, the crown effective length can be defined as a specific pixel radius selected from a plurality of pixel radii according to orientation or length characteristics of the pixel radii. In addition, the crown effective length can be selected to define a ratio of a second point location (number of points) along the crown effective length from the maximum intensity point to a total number of points along the crown effective length to the crown perimeter.

Selected Wood Type Club Head Intensity Profiles

For purposes of illustration, intensity profile results for selected club heads are described. For convenience, examples include both contrast-enhanced clubs and conventional clubs to illustrate differences. In addition, CIELab data and gloss values are provided for selected embodiments associated with contrast-enhancement as well as some conventional club heads.

A representative intensity contour map associated with a conventional glossy black club head crown (club 1) is provided in FIG. **21**. The graph of FIG. **21** plots relative image intensity about axes extending along a plurality of angles (0 to 330 degrees in 30 degree increments) on the club head crown as shown in FIG. **22**. In addition, FIG. **22** also includes representative contour lines associated with constant relative surface brightness. The contour lines are provided for convenient illustration only, and actual contour line locations are based on data such as that used in FIG. **21**. FIG. **21** show that relative surface intensity declines from its maximum value to near zero in fewer than about 5 points along the pixel radius. A crown portion in which relative intensity is greater than about 0.7 has a radius of less than about 4 points, indicative of a hot spot associated with this conventional club's glossy crown. The remainder of the crown appears dark, having a relative intensity of less than 0.004. Thus, this conventional crown has a pronounced hot spot on an otherwise dark surface.

FIGS. **23-24** illustrate hot spot reduction and an enlarged light diffusing area associated with application of a matte coating to a crown (club 2) similar to that associated with FIGS. **21-22**. Considerable spreading of the crown hot spot is apparent, with relative intensity dropping to near zero over about a 20 point radius, and a crown effective length associated with an intensity of greater than about 0.7 is based on a distance corresponding to about 10 points in FIGS. **23-24**. Nevertheless, a substantial portion of this matte crown has low intensity (less than 0.05 at points greater than 25) with the exception of a slight increase in intensity near the crown perimeter.

FIG. **25** is a graph of crown intensity and FIG. **26** is an intensity contour map for a metal wood driver (club 3) crown surface that is provided by a contrast-enhancing coated that includes a primer layer, a white base coat of thickness 0.00125 in. or about 0.001-0.002 in., a pearl layer of thickness 0.0008 in. or about 0.0007-0.0009 in., and a topmost matte clear layer of thickness 0.0008 in. or about 0.0007-0.0009 inches. Representative club heads have volumes greater than 400 cm^3 and crown thicknesses of between 0.7 and 1.0 mm, or 0.8 and 0.9 mm. In some examples, metalwoods have volumes of at least 400 cm^3 and crowns of thickness less than or equal to about 0.8 mm over more than 40%, 50%, or 60% of the crown surface area. Alternatively, crown thickness can be less than 1.0 mm, 0.9 mm, or 0.85 mm over 40%, 50%, or 60% of the crown surface area. In one embodiment, the base coat thickness is the thickest layer of the individual coating layers to achieve a desired diffusivity. In another embodiment, the primer coat has a thickness of about 40-60 μm, the paint layer has a thickness of about 75-95 μm, and the clear coat layer has a thickness of about 105-125 μm.

Considerable improvement is apparent, with relative intensity dropping to about 0.7 of a maximum value at about 20-40 points, and not approaching zero except when the club head perimeter is reached. With reference to FIG. **26**, it will be appreciated that along radii at some angles, the relative intensity reduction is primarily associated with proximity to the crown perimeter, indicating that such a crown would have a substantially uniform light diffusing appearance over a large surface portion. Indeed, crown intensity does not drop to zero as with a conventional, glossy crown. The diffusing surface of this crown tends to reduce hot spots and the white surface treatment tends to increase surface intensity over that of a black crown, producing the substantially uniform crown intensity.

FIGS. **27-28** are graphs of crown intensity for two conventional metal wood type clubs (club 4 and club 5, respectively) that are provided with surfaces that are not black. As with the conventional glossy black crown of FIGS. **21-22**, crown intensity decreases rapidly from a relative intensity maximum to about 0.7 at less than about 5-8 points. In addition, perimeter portions of the crown (points greater than about 15) have intensities of less than about 0.1. Thus, these conventional clubs also exhibit pronounced and visually distracting hot spots.

FIGS. **29-30** provide intensity data and contour maps for a conventional solid composite construction fairway wood (club 6). By virtue of its composite construction and a cream-colored appearance, hot spots do not appear. As this club is a solid composite, its club face is also a composite face of similar appearance to the crown, in contrast to the metal woods described above that have metallic striking faces.

FIG. **31** is a graph of intensity data for another conventional metal type driver (club 7) having a light (non-black) crown. As is readily apparent, this club too exhibits a significant hot spot.

FIG. **32** is a summary graph illustrating crown reflected light intensity for a variety of wood type club heads as described above. For each club head, data along a pixel radius at 0 degrees was selected.

Selected Wood Type Club Head Colorations

CIELab coordinates for the club head crowns associated with FIGS. **21-31** are provided in Tables 2A-2B below. Larger L* values appear brighter, and smaller absolute values of a* and b* are associated with more color neutral appearance. In addition, small values of chroma (C*) are accordingly also associated with a more color neutral appearance. As noted above, the composite club head associated with FIGS. **29-30** has relatively large b* and C* values, as well as a relatively low L* value. Thus, this club appears cream colored, and not white. The remaining conventional club crowns also have low L* values, and thus do not have a bright white appearance, and do not provide the contrast-enhancement available with the diffusing white club associated with FIGS. **25-26** which has an L* value of 93 and a C* value of less than 1.3, indicating a bright white, color neural appearance. This club head can also be configured to have a semigloss surface with gloss values in ranges from 10-70, 20-60, 30-50, or 35-45 gloss units or any other sub-range within the semigloss range defined above. In addition, club head crowns can also be configured to have lower gloss values (in the low gloss range). While such club head crowns can provide enhanced contrast and do not tend to exhibit hot spots, such low glosses tend to appear chalky and may not appeal to some golfers for this reason.

TABLE 2A

CIELab values or crowns of selected wood-type golf clubs.

	Club Identifier					
	4			3		
Illuminant	D65	A	F2	D65	A	F2
L*	75.74	76.03	75.98	93.17	93.04	93.11
a*	0.40	1.12	0.23	−1.22	−1.06	−0.74
b*	3.59	3.87	4.14	0.20	−0.28	0.03
C*	3.62	4.03	4.15	1.24	1.10	0.74
h	83.64	73.81	86.80	170.83	195.04	177.97

TABLE 2B

CIELab values for crowns of selected wood-type golf clubs.

	Club Identifier					
	6			7		
Illuminant	D65	A	F2	D65	A	F2
L*	67.06	67.95	67.76	81.44	81.74	81.71
a*	−2.09	1.99	−1.60	1.02	1.38	0.66
b*	17.97	17.74	20.43	2.68	3.10	3.14
C*	18.09	17.85	20.50	2.87	3.39	3.21
h	96.63	83.60	94.49	69.19	66.02	78.14

Striking Face Characteristics

A contrast-enhanced crown provides the golfer with superior visibility of a club head at address, increases the apparent (visual) size of the club head, and eliminates or reduces distracting hot spots. With such a club head, the golfer can better visualize ball/club alignment at address. To further improve golfer perception, a club head with a contrast enhanced crown can be provided with a contrasting striking face so that a top portion of a crown/striking face boundary becomes more apparent. For a white, diffusing crown, a dark or black appearing striking face can be used. CIELab values for a representative black striking face as well as several conventional clubs referred to above are included in Table 3.

TABLE 3

CIELab values for various club striking faces.

	Club Identifier								
	4			3			6		
Illuminant	D65	A	F2	D65	A	F2	D65	A	F2
L*	39.66	39.91	39.82	25.39	25.32	25.35	66.12	67.01	66.80
a*	0.43	1.18	0.26	−0.20	−0.38	−0.15	−1.78	2.18	−1.40
b*	2.93	3.16	3.36	−0.65	−0.73	−0.72	17.47	17.34	19.87
C*	2.96	3.37	3.37	0.67	0.82	0.74	17.56	17.48	19.92
h	81.55	69.49	85.58	252.97	242.67	258.53	95.81	82.82	94.04

Referring to Tables 2-3, a contrast enhanced club crown coupled with a black or other contrasting striking face can have a crown-face brightness difference ΔL of about 68, but greater or lesser differences can be used, for example, differences of about 20, 40, 50, 60, or 70 can be provided. The higher the ΔL value between the crown and face, the easier it will be for the golfer to align the face angle at the address position. In one embodiment, a ΔL of greater than 40 is preferred. In another embodiment, a ΔL of greater than about 50 or 60 is even more preferred to provide a very high contrast from the crown to face.

With reference to FIG. **33**, a representative club head **3000** includes a hosel end **3002**, a crown **3004**, and a striking face **3005**. A top edge **3006** of the striking surface is adjacent a portion of the crown **3004** that is forward facing and defines an upper crown/striking face boundary. As shown in FIG. **33**, the club head is situated in an address position with reference to a horizontal surface **3010**. A second plane **3012** is parallel to a first plane **3014**. The first plane **3014** is tangent to the hosel end **3002** and the second plane **3012** is offset towards the horizontal surface **3010** along a hosel axis **3016** by an offset distance of 15 mm. The hosel axis **3016** is contained within a hosel plane that is perpendicular to the horizontal surface **3010**. In other words, the hosel plane is parallel to the page surface and contains the hosel axis **3016**. The hosel axis **3016** and the second plane **3012** intersect at a first intersection point. A first vertical plane s0 is taken through the first intersection point p0. The first vertical plane s0 is perpendicular to the hosel plane. As shown in FIG. **21**, the first intersection point p0 corresponds to an intersection of the first vertical plane s0, the second plane **3012**, and the striking face **3005** surface. In other words, the first face intersection point p0 is contained within the striking face **3005**, the second plane **3012**, and the first vertical plane s0. A plurality of crown/striking face boundary points p1, . . . , p6 can be evenly or otherwise spaced along the top edge **3006** of the striking surface **3005**. In some examples, such points are equidistant as measured along a horizontal direction parallel to the horizontal surface **3010**. A point p7 identifies a most distant portion of the club head **3000** on the toe end of the club head **3000**. A toe-end plane or seventh vertical plane s7 is defined to be tangent at the toe end point p7 and is perpendicular to the hosel plane.

With the first vertical plane s0 and the seventh vertical plane s7 defined as above, a face distance f_d between the two planes s0, s7 is determined in a horizontal direction along the ground plane **3010**. The face distance f_d is evenly divided into seven horizontally equidistant regions by planes s1 . . . s6. As shown in FIG. **33**, planes s0, . . . , s7 are defined as planes perpendicular to the hosel plane and the horizontal plane **3010** and contain points p0, . . . , p7 located on the striking surface **3005**, respectively. Each dividing plane s1 . . . s6 contains a respective contrast point p1 . . . p6 located near the face to crown transition region. The contrast points p1 . . . p6 correspond to points on the face associated with color transitions from a dark color to a light color of the crown. A transition from a dark color to a light color can be defined as "high contrast" if the L* values between face and the crown differ by more than 50. In some embodiments, the L* values between the crown color and the face color differ by more than 60 or 65.

In some embodiments, the difference in L* values between the crown and the face is high contrast, as defined above, for more than about 14.3% of the face distance f_d (at least one of the equidistant regions is high contrast). In other embodiments, the difference in L* values between the crown and the face is high contrast, as defined above, for more than about 28.6% of the face distance f_d (at least two of the equidistant regions are high contrast). In other embodiments, the difference in L* values between the crown and the face is high contrast, as defined above, for more than about 42.9% of the face distance f_d (at least three of the equidistant regions are high contrast). In other embodiments, the difference in L* values between the crown and the face is high contrast, as defined above, for more than about 57.1% of the face distance f_d (at least four of the equidistant regions are high contrast). In other embodiments, the difference in L* values between the crown and the face is high contrast, as defined above, for more than about 71.4% of the face distance f_d (at least five of the equidistant regions are high contrast). In other embodiments, the difference in L* values between the crown and the face is high contrast, as defined above, for more than about 85.7% of the face distance f_d (at least six of the equidistant regions are high contrast). In other embodiments, the difference in L* values between the crown and the face is high contrast, as defined above, for more than about 99% of the face distance f_d (at least six of the equidistant regions are high contrast along with a significant portion of the seventh equidistant region)

The equidistant regions of high contrast mentioned above can be contiguous across the face to crown transition or they can be spaced apart from one another in alternating or random fashion across the face to crown transition. In one embodiment, six out of the seven equidistant regions contain a high contrast crown to face transition across the entire horizontal distance (measured along f_d) within each region. In some embodiments, two, three, four, or five out of the seven equidistant regions contain a high contrast crown to face transition across the entire horizontal distance within each region.

In the view of FIG. **33**, the planes s0, . . . , s6 define respective projection crown lengths **3031**-**3036** and striking face projection lengths **3041**-**3046** that extend along the projections of the crown and the striking surface into the hosel plane (i.e., into a plane parallel to the drawing sheet. In typical examples, the crown **3004** is configured to be a white diffuser as described above, and the striking face **3005** is configured to be a dark or black diffuser with the exception of scorelines or striking face ornamentations. In representative examples, a set of such crown and striking face projection lengths includes projection lengths for which ratios of a striking face projection length to a corresponding crown projection length are in a range of from about 3:2 to about 10:1, and a set of evenly space projections includes ratios in this range, or ranges of 2:1 to 8:1 or 3:1 to 7:1.

Selected Putter Intensity Profiles and Colorations

Some representative putter intensity profiles, CIELab color values, and gloss data are provided below for contrast-enhanced putters as well as conventional putters. In some embodiments, putter top surfaces are painted, coated, or otherwise prepared to have color values similar to those associated with a golf ball. Representative CIELab values for golf balls are provided in Table 4 below.

TABLE 4

CIELab values for three types of golfballs having a white appearance.

	Ball Identifier								
	1			2			3		
Illuminant	D65	A	F2	D65	A	F2	D65	A	F2
L*	91.34	90.41	90.45	91.37	90.61	90.67	91.32	90.41	90.44
a*	−1.78	−3.18	−0.77	−1.91	−2.82	−0.85	−1.81	−3.15	−0.82
b*	−9.69	−11.31	−12.03	−7.39	−8.92	−9.41	−9.40	−10.97	−11.66
C*	9.86	11.75	12.05	7.63	9.36	9.45	9.57	11.42	11.69
h	259.57	254.30	266.32	255.54	252.48	264.86	259.08	253.98	265.97

CIELab values for various putter configurations are summarized in Tables 5-6. Table 5 contains data for conventional putters, and Table 6 contains data for contrast-enhanced putter heads similar in shape to the putter head of FIGS. **12**A-**12**D.

TABLE 5

CIELab coordinates for selected conventional putters.

	Putter Identifier					
	14			27		
Illuminant	D65	A	F2	D65	A	F2
L*	86.61	86.66	86.68	92.17	91.71	91.78
a*	−1.04	−0.36	−0.66	−2.25	−2.44	−1.53
b*	2.29	1.96	2.50	−2.90	−3.91	−3.62
C*	2.52	1.99	2.59	3.68	4.61	3.93
h	114.42	100.52	104.89	232.18	237.97	247.12

TABLE 6

CIELab coordinates for selectee contrast-enhanced putters.

	Putter Identifier											
	9			12			10			11		
Illuminant	D65	A	F2	D65	A	F2	D65	A	F2	D65	A	F2
L*	64.37	64.35	64.38	89.33	88.95	89.02	91.68	91.21	91.25	24.61	24.55	24.58
a*	−0.33	−0.27	−0.23	−1.83	−2.07	−1.19	−2.69	−2.57	−1.80	−0.04	−0.24	−0.03
b*	0.36	0.30	0.43	−2.43	−3.23	−2.97	−2.24	−3.35	−2.92	−0.72	−0.76	−0.81
C*	0.49	0.40	0.49	3.04	3.83	3.20	3.51	4.22	3.43	0.72	0.79	0.81
h	131.85	132.13	118.41	233.00	237.35	248.17	219.82	232.43	238.31	267.18	252.36	268.06

A top surface of Putter #10 is provided by a primer coating over which a base coat is applied. A top surface of Putter #12 is provided by a primer coating, followed by a base coating that is covered by a matte clear coat. Data for mechanically similar putter heads with a matte clear coat and a flat black coating are also provided in Table 6.

FIG. **34** illustrates surface brightness along 120 degree and 270 degree radii for a putter head having a matte coating and a gray diffuse appearance (Putter #9). The dips in normalized intensity around point numbers 10-15 are due to black alignment grooves, and the intensity decrease at 270 degrees for point numbers 25 and larger appears to be associated with a putter head feature corresponding to the rear arc **116** shown in FIG. **12**A. Over the remainder of the putter head top surface, surface brightness remains greater than about 70% of a maximum brightness.

FIG. **35** illustrates surface brightness along 120 degree and 300 degree radii for a putter head having a white diffusing coating (Putter #12). The dips in normalized intensity around point numbers 4, 12, and 19 are due to black alignment grooves. Over the remainder of the putter head top surface, surface brightness remains greater than about 40% of a maximum brightness. FIG. **36** illustrates corresponding representative surface brightness contours and radii orientations. The contours of FIG. **36** are shown without the surface brightness decreases in the alignment grooves.

FIG. **37** illustrates surface brightness along 120 degree and 270 degree radii for a putter head having a white diffusing coating (Putter #10). The dips in normalized intensity around point numbers 2 and 15 are due to black alignment grooves. Over the remainder of the putter head top surface, surface brightness remains greater than about 65% of a maximum brightness.

The thickness of the paint coating can vary based on the type of material being painted. For example, in one embodiment, a steel body is painted with a primer layer and white paint layer having a combined thickness of about 45-60 μm and a clear coat layer of about 50-60 μm. In another embodiment, an aluminum body is painted with a primer layer and a white paint layer having a combined thickness of about 25-40 m and a clear coat layer of about 30-40 μm.

FIG. **38** illustrates surface brightness along 120 degree and 270 degree radii for a conventional putter head (Putter #13). The dip in normalized intensity around point number 14 is associated with club head markings. The surface brightness varies widely, and drops to less than 35% of a maximum value over only about 4 points, and remains less than about 25-30% of a maximum value over a substantial portion of the surface. Such a brightness curve is indicative of a pronounced hot spot.

FIG. **39** is a top perspective view of another conventional putter head **3100** (Putter #14) and FIG. **40** is a graph of surface brightness. This putter head **3100** includes a set of periodic grooves such a groove **3102** and the associated surface brightness drops periodically to near zero as a result, resulting in a reduced apparent intensity when viewed by a golfer. Brightness contour lines are shown in FIG. **39** absent the drop offs associated with the grooves.

The above describes only representative examples with reference to the shortcomings of conventional club heads. Embodiments of the disclosed club heads can provide high contrast and high visibility with respect to typical backgrounds against which a club head is viewed. For example, bright white (such as color neutral surfaces with CIELab L* of greater than 75 and less than 100, a chroma of less than 2) provides superior contrast with respect to grass playing surfaces. In addition, providing a diffusely reflecting surface such as a semigloss surface with a gloss of less than about 60 gloss units, visually distracting hot spots can be eliminated or reduced. In combination with bright white, such a surface appears to have a uniform high brightness to a golfer. Finally, a club face that contrast with a bright white upper surface provides a high face/crown contrast that can be used for shot alignment. However, it will be appreciated that there are many club head variations that offer some or all of these advantages, and the claims are not to be limited so as to require any or all of these advantages. Therefore, we claim all that is encompassed by the appended claims.

In addition to the alignment features described herein, the golf club heads of the present invention may also incorporate additional, such features including but not limited to:

1. movable weight features including those described in more detail in U.S. Pat. Nos. 6,773,360, 7,166,040, 7,452,285, 7,628,707, 7,186,190, 7,591,738, 7,963, 861, 7,621,823, 7,448,963, 7,568,985, 7,578,753, 7,717,804, 7,717,805, 7,530,904, 7,540,811, 7,407, 447, 7,632,194, 7,846,041, 7,419,441, 7,713,142, 7,744,484, 7,223,180, 7,410,425 and 7,410,426, the entire contents of each of which are incorporated by reference in their entirety herein;
2. slidable weight features including those described in more detail in U.S. Pat. Nos. 7,775,905 and 8,444,505, U.S. patent application Ser. No. 13/898,313 filed on May 20, 2013, U.S. patent application Ser. No. 14/047, 880 filed on Oct. 7, 2013, the entire contents of each of which are hereby incorporated by reference herein in their entirety;
3. aerodynamic shape features including those described in more detail in U.S. Patent Publication No. 2013/ 0123040A1, the entire contents of which are incorporated by reference herein in their entirety;

4. removable shaft features including those described in more detail in U.S. Pat. No. 8,303,431, the contents of which are incorporated by reference herein in in their entirety;
5. adjustable loft/lie features including those described in more detail in U.S. Pat. Nos. 8,025,587, 8,235,831, 8,337,319, U.S. Patent Publication No. 2011/0312437A1, U.S. Patent Publication No. 2012/0258818A1, U.S. Patent Publication No. 2012/0122601A1, U.S. Patent Publication No. 2012/0071264A1, U.S. patent application Ser. No. 13/686,677, the entire contents of which are incorporated by reference herein in their entirety; and
6. adjustable sole features including those described in more detail in U.S. Pat. No. 8,337,319, U.S. Patent Publication Nos. US2011/0152000A1, US2011/0312437, US2012/0122601A1, and U.S. patent application Ser. No. 13/686,677, the entire contents of each of which are incorporated by reference herein in their entirety.

The designs, embodiments and features described herein may also be combined with other features and technologies in the club-head including:

1. variable thickness face features described in more detail in U.S. patent application Ser. No. 12/006,060, U.S. Pat. Nos. 6,997,820, 6,800,038, and 6,824,475, which are incorporated herein by reference in their entirety;
2. composite face plate features described in more detail in U.S. patent application Ser. Nos. 11/998,435, 11/642,310, 11/825,138, 11/823,638, 12/004,386, 12/004,387, 11/960,609, 11/960,610 and U.S. Pat. No. 7,267,620, which are herein incorporated by reference in their entirety;

One should note that conditional language, such as, among others, "can," "could," "might," or "may," unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements and/or steps. Thus, such conditional language is not generally intended to imply that features, elements and/or steps are in any way required for one or more particular embodiments or that one or more particular embodiments necessarily include logic for deciding, with or without user input or prompting, whether these features, elements and/or steps are included or are to be performed in any particular embodiment.

It should be emphasized that the above-described embodiments are merely possible examples of implementations, merely set forth for a clear understanding of the principles of the present disclosure. Any process descriptions or blocks in flow diagrams should be understood as representing modules, segments, or portions of code which include one or more executable instructions for implementing specific logical functions or steps in the process, and alternate implementations are included in which functions may not be included or executed at all, may be executed out of order from that shown or discussed, including substantially concurrently or in reverse order, depending on the functionality involved, as would be understood by those reasonably skilled in the art of the present disclosure. Many variations and modifications may be made to the above-described embodiment(s) without departing substantially from the spirit and principles of the present disclosure. Further, the scope of the present disclosure is intended to cover any and all combinations and sub-combinations of all elements, features, and aspects discussed above. All such modifications and variations are intended to be included herein within the scope of the present disclosure, and all possible claims to individual aspects or combinations of elements or steps are intended to be supported by the present disclosure.

We claim:

1. A putter head, comprising:

a top portion, a sole portion, opposite the top portion, a forward portion comprising a striking face that extends between the top portion and the sole portion, and a rearward portion, opposite the forward portion;

wherein:

the top portion comprises an upward-facing surface portion and a diffusely reflecting surface area of at least 5% of a total upward-facing surface portion area, with the diffusely reflecting surface area having a gloss value of less than 60 gloss units and a CIELab L* value of at least 50;

the putter head has an alignment feature delineating a transition between at least a first portion of the upward-facing surface portion having an area of contrasting shade or color with a shade or color of a portion of the striking face adjacent the upward-facing surface portion;

at least a portion of the striking face adjacent the upward-facing surface portion has a diffusely reflecting face surface area with a chroma value of less than 10 and a gloss value of less than 60 gloss units;

wherein the alignment feature has:

a. a Sight Adjusted Perceived Face Angle (SAPFA) of from about −2 to about 10 degrees; and

b. a Sight Adjusted Perceived Face Angle 25 mm Heelward ($SAPFA_{25H}$) of from about −5 to about 2 degrees; and

c. a Sight Adjusted Perceived Face Angle 25 mm Toeward ($SAPFA_{25T}$) of from 0 to about 9 degrees.

2. The putter head of claim **1**, wherein the alignment feature has a contrasting color difference (ΔE*ab) greater than 60, wherein the contrasting color difference (ΔE*ab) is between the first portion of the upward-facing surface portion and a portion of the striking face.

3. The putter head of claim **2**, wherein the diffusely reflecting face surface area has a CIELab L* value of less than 40.

4. The putter head of claim **3**, wherein the diffusely reflecting face surface area has a chroma value of less than 4.

5. The putter head of claim **4**, wherein the diffusely reflecting face surface area has a chroma value of less than 1 and a CIELab L* value of less than 30, and further includes a CIELab ΔL difference value between a CIELab L* value of a portion of the striking face and the CIELab L* value of the diffusely reflecting surface area of the upward-facing surface portion, wherein the CIELab ΔL difference value is at least 60.

6. The putter head of claim **4**, wherein the first portion of the upward-facing surface portion is adjacent a portion of the striking face.

7. The putter head of claim **2**, further having a CIELab ΔL difference value between a CIELab L* value of a portion of the striking face and the CIELab L* value of the diffusely reflecting surface area of the upward-facing surface portion, wherein the CIELab ΔL difference value is at least 20.

8. The putter head of claim **2**, further including an electronic display on at least a portion of the upward-facing surface portion, wherein the electronic display is a user adjustable display.

9. The putter head of claim 8, wherein a portion of the electronic display comprises the diffusely reflecting surface area of the upward-facing surface portion.

10. The putter head of claim 9, wherein the diffusely reflecting surface area of the upward-facing surface portion comprises a white surface portion and has a gloss value of less than 45 gloss units.

11. The putter head of claim 10, wherein the upward-facing surface portion further comprises at least three alignment indices, visible from an address orientation, parallel relative to each other, aligned perpendicular to the striking face, and contrasting with the diffusely reflecting surface area and a portion of the striking face.

12. The putter head of claim 9, wherein the electronic display comprises the alignment feature.

13. The putter head of claim 12, wherein the diffusely reflecting surface area of the upward-facing surface portion includes the first portion of the upward-facing surface portion.

14. The putter head of claim 12, wherein an edge of the electronic display comprises the alignment feature.

15. The putter head of claim 14, wherein the electronic display includes a secondary alignment feature extending toward the rearward portion.

16. The putter head of claim 15, wherein the secondary alignment feature is user adjustable.

17. The putter head of claim 8, wherein the electronic display includes a secondary alignment feature that is user adjustable.

18. The putter head of claim 17, wherein the orientation of the secondary alignment feature is user adjustable and changes a Sight Adjusted Perceived Face Angle Secondary Alignment Feature ($SAPFA_{SAF}$), and the secondary alignment feature contrasts with the diffusely reflecting surface area.

19. The putter head of claim 17, wherein the secondary alignment feature has at least one elongate side having a side length that is at least one inch.

20. The putter head of claim 17, wherein a portion of the electronic display is curved.

21. The putter head of claim 17, wherein the electronic display comprises an e-ink display.

22. The putter head of claim 8, wherein the electronic display is configured to wirelessly communicate with a user operable electronic device.

23. The putter head of claim 22, wherein the electronic display is configured to receive and display one or more images from the user operable electronic device.

24. The putter head of claim 8, wherein the electronic display further includes a circular alignment feature having a diameter between about 20 mm and 75 mm.

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