



US 20110269567A1

(19) **United States**

(12) **Patent Application Publication**
BAN et al.

(10) **Pub. No.: US 2011/0269567 A1**

(43) **Pub. Date: Nov. 3, 2011**

(54) **GOLF CLUB HEAD**

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(21) Appl. No.: **13/050,392**

(22) Filed: **Mar. 17, 2011**

(30) **Foreign Application Priority Data**

Apr. 30, 2010 (JP) 2010-105955

Publication Classification

(51) **Int. Cl.**
A63B 53/04 (2006.01)

(52) **U.S. Cl.** **473/331**

(57) **ABSTRACT**

This invention provides a golf club head in which a plurality of scorelines are formed in its face surface. The golf club head includes a first fine groove formed in the face surface to extend parallel to the scorelines, and a second fine groove formed in the face surface to intersect with the first fine groove.

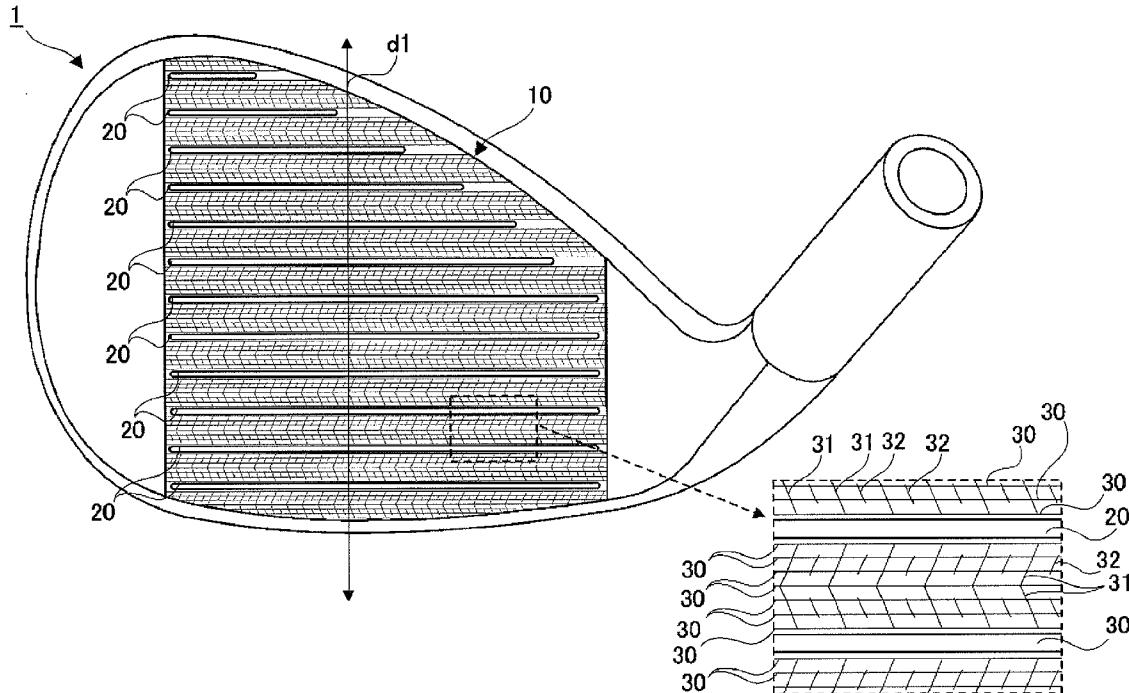
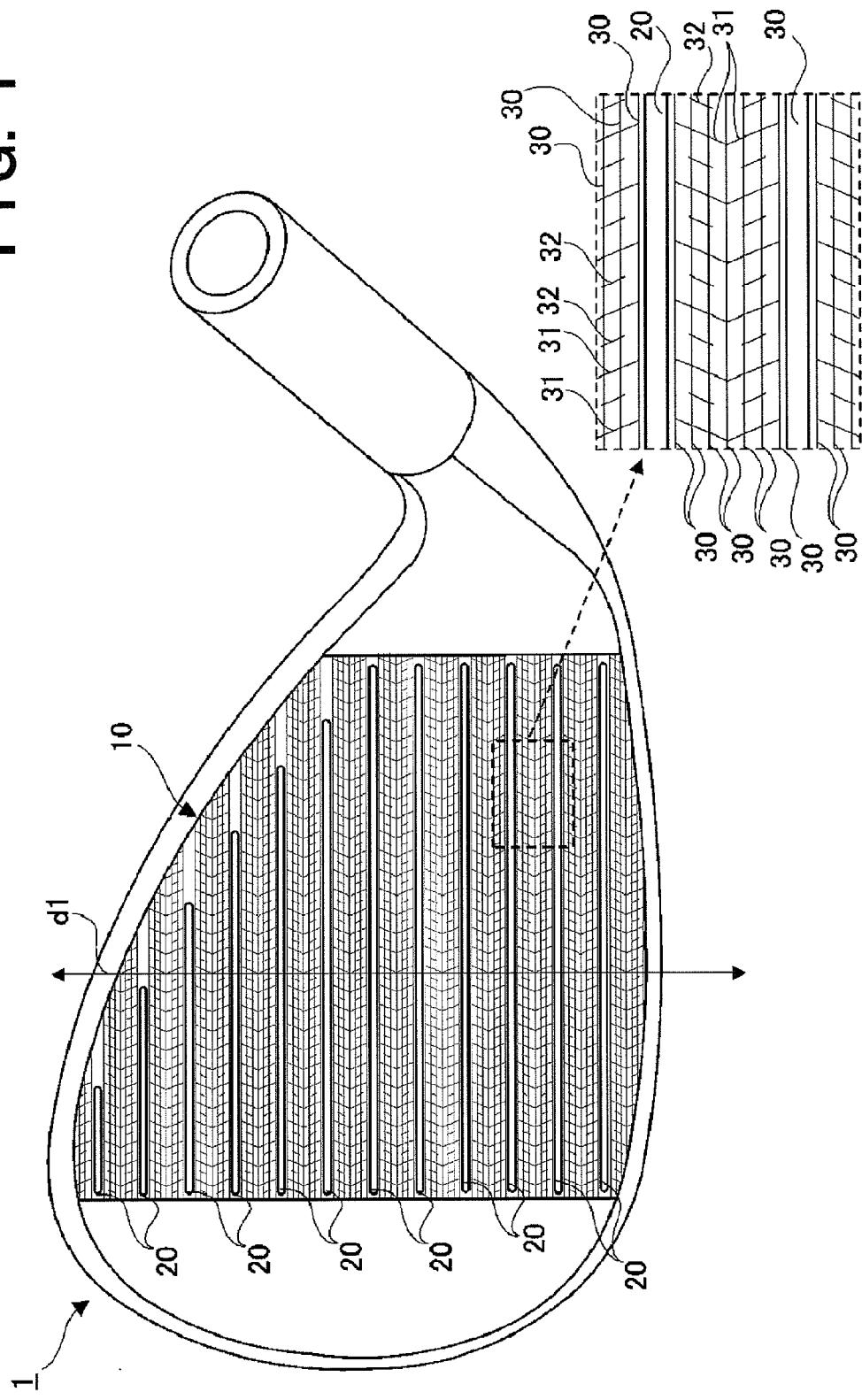


FIG. 1



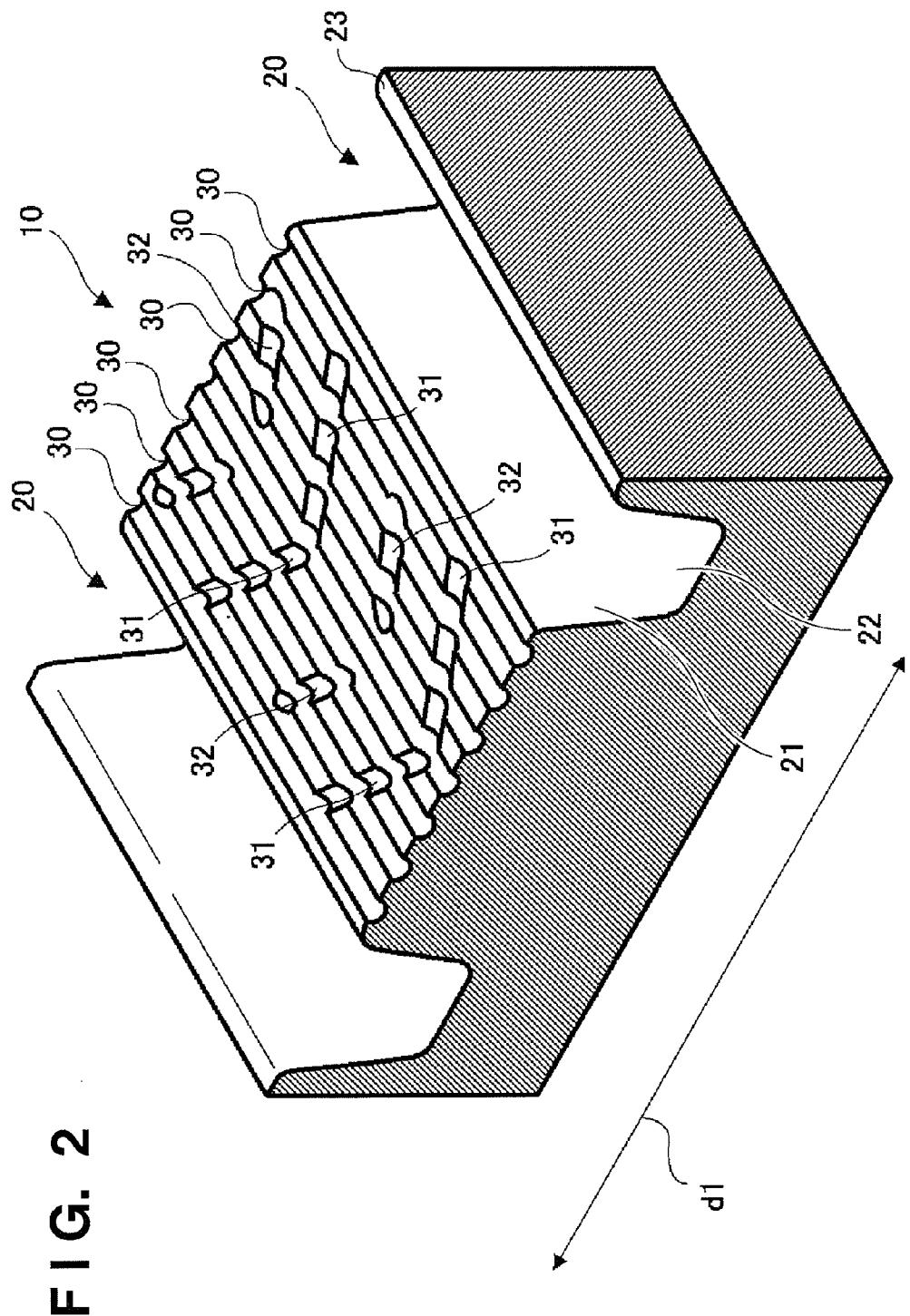


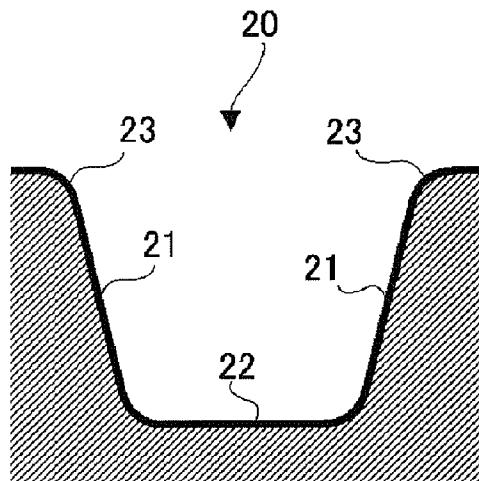
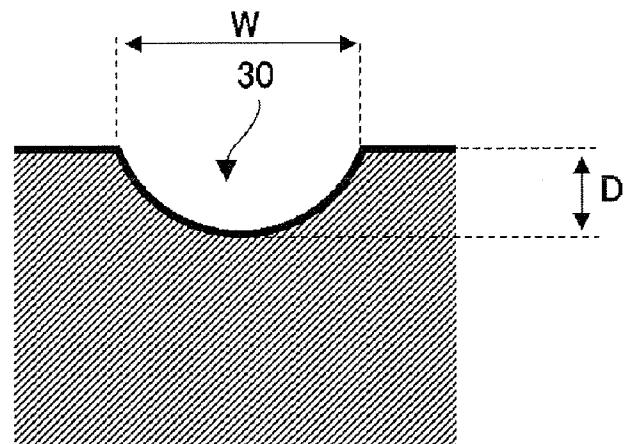
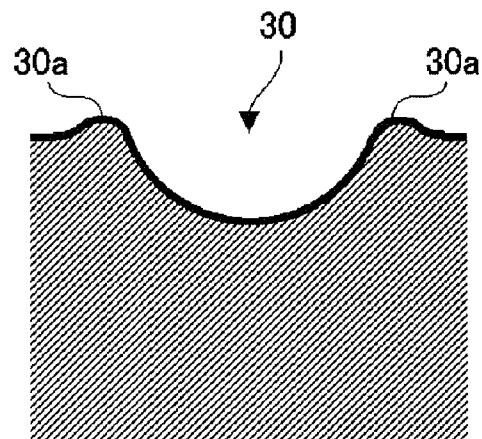
FIG. 3A**FIG. 3B****FIG. 3C**

FIG. 4

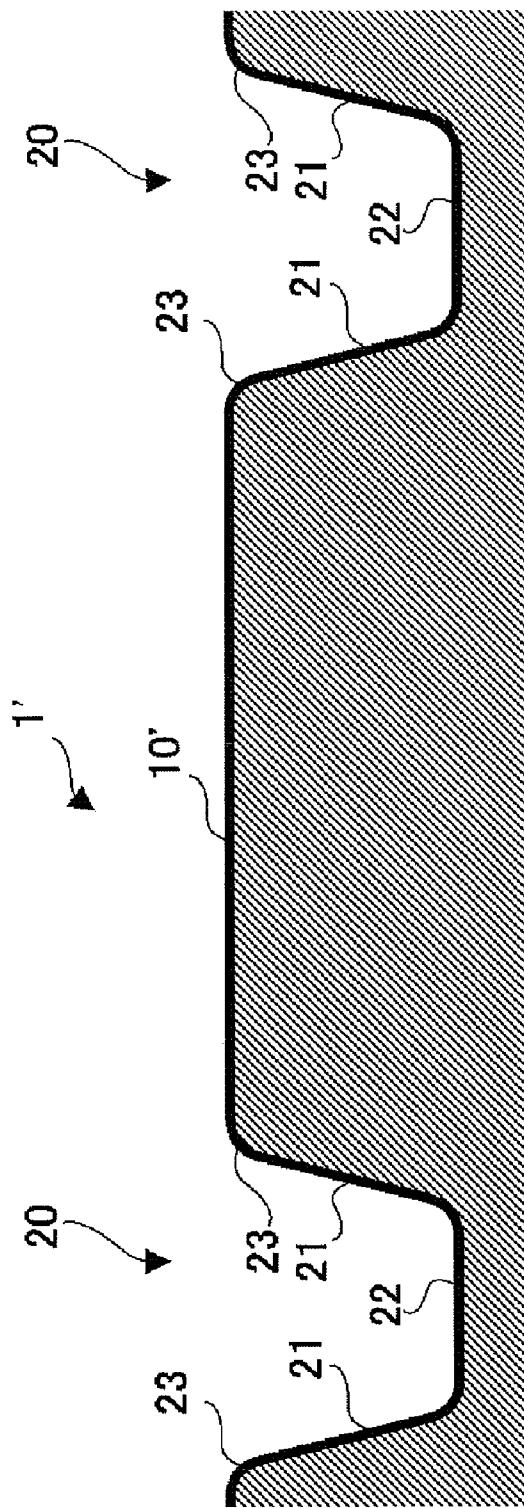
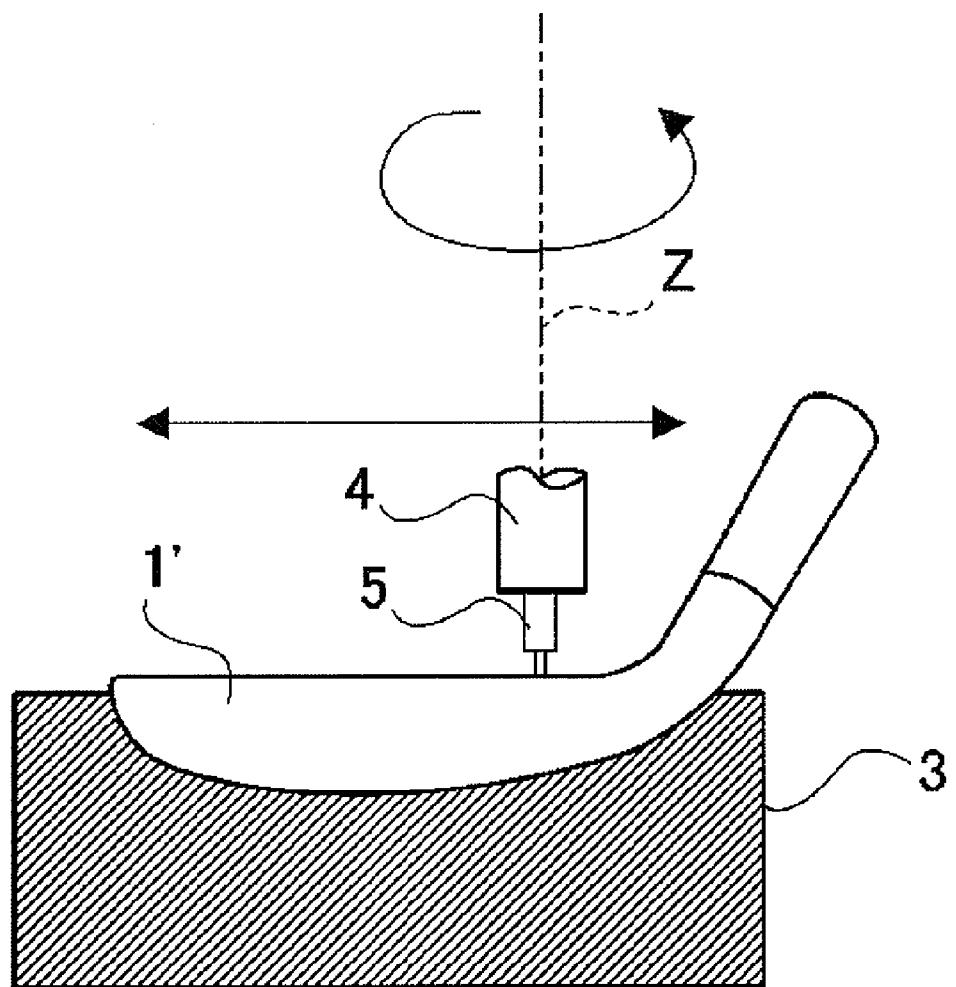
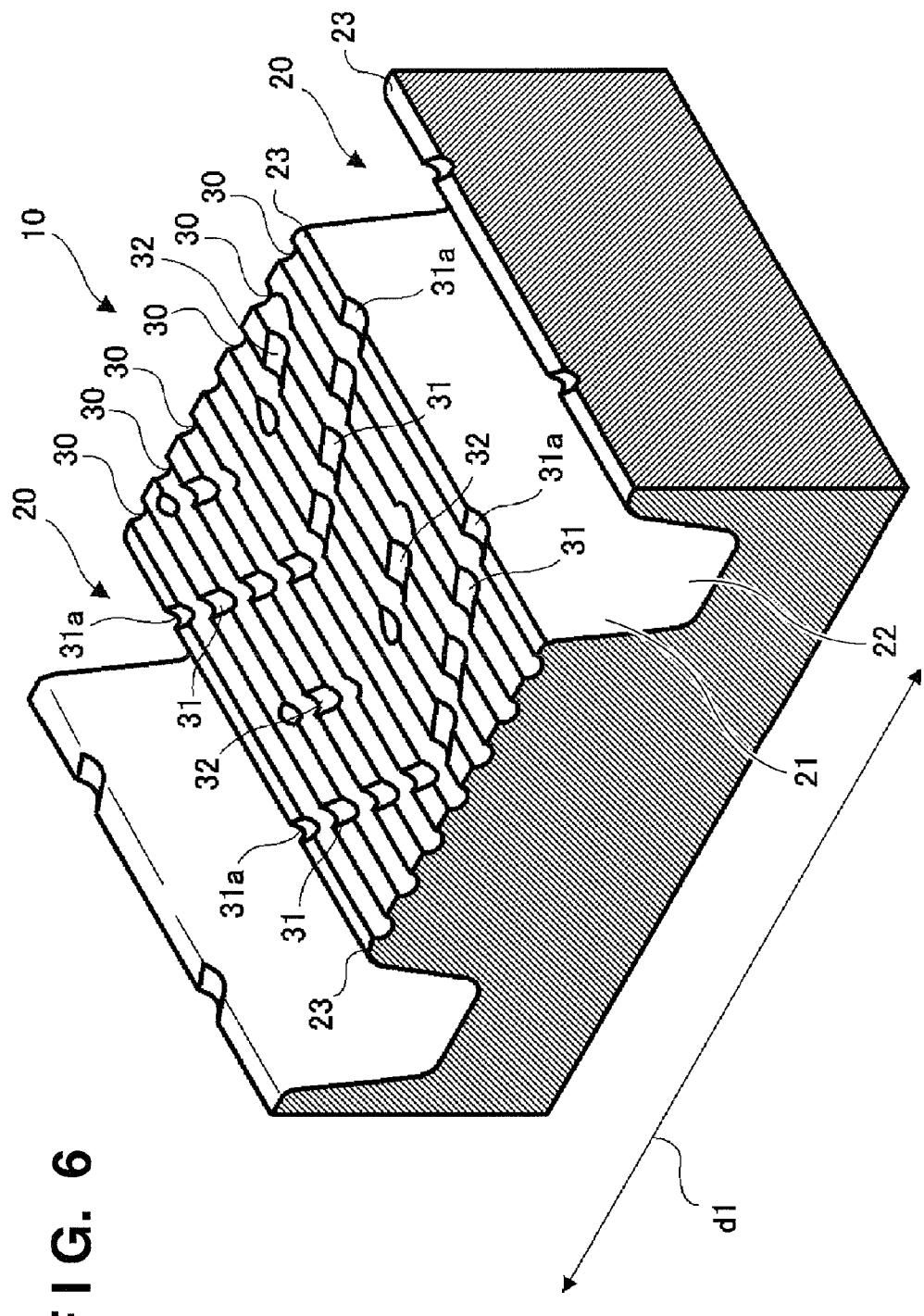


FIG. 5





GOLF CLUB HEAD

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention
 [0002] The present invention relates to a golf club head.
 [0003] 2. Description of the Related Art
 [0004] In general, a plurality of parallel linear grooves are formed in the face surface of a golf club head to extend in the toe-to-heel direction. These grooves are called, for example, scorelines, marking lines, or face lines (they will be referred to as scorelines in this specification). These scorelines have an effect of increasing the back spin amount on a struck golf ball, or suppressing a significant decrease in back spin amount on a struck golf ball upon a shot in rainy weather or that from the rough.

[0005] Unfortunately, the use of only the scorelines has limits of increasing the back spin amount and of suppressing a decrease in back spin amount. Under the circumstance, techniques of forming grooves finer than the scorelines in the face surface have been proposed (for example, Japanese Patent Laid-Open No. 2007-202633). These fine grooves are effective in preventing a decrease in back spin amount on a struck golf ball.

[0006] However, the grooves finer than the scorelines are readily filled with water droplets because they are finer than the scorelines. Hence, these grooves often cannot satisfactorily exhibit an effect of suppressing a decrease in back spin amount upon a shot in rainy weather or that from the rough.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to improve an effect of suppressing a decrease in back spin amount by grooves finer than scorelines.

[0008] According to the present invention, there is provided a golf club head comprising: a plurality of scorelines are formed in a face surface thereof; a first fine groove formed in the face surface to extend parallel to the scorelines; and a second fine groove formed in the face surface to intersect with the first fine groove.

[0009] Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 shows an external view of a golf club head 1 and a partial enlarged view of a face surface 10 according to an embodiment of the present invention;

[0011] FIG. 2 is a partial sectional perspective view of the face surface 10;

[0012] FIG. 3A is a sectional view of a scoreline 20 taken in a direction perpendicular to its longitudinal direction (the toe-to-heel direction);

[0013] FIG. 3B is a sectional view of a fine groove 30 taken in a direction perpendicular to its longitudinal direction;

[0014] FIG. 3C is a sectional view of a fine groove 30 in another example taken in a direction perpendicular to its longitudinal direction;

[0015] FIG. 4 is a sectional view showing a primary shaped product 1' before fine grooves 30 to 32 are formed;

[0016] FIG. 5 is a view for explaining a method of forming fine grooves 30 by an NC milling machine; and

[0017] FIG. 6 is a partial sectional perspective view of a face surface 10, which shows another example of the fine grooves 31.

DESCRIPTION OF THE EMBODIMENTS

First Embodiment

[0018] FIG. 1 shows an external view of a golf club head 1 and a partial enlarged view of a face surface 10 according to an embodiment of the present invention. FIG. 1 illustrates an example in which the present invention is applied to an iron type golf club head. The present invention is suitable for an iron type golf club head and, more particularly, for middle iron, short iron, and wedge type golf club heads. More specifically, the present invention is suitable for a golf club head with a loft angle of 30° (inclusive) to 70° (inclusive) and a head weight of 240 g (inclusive) to 320 g (inclusive). However, the present invention is also applicable to wood type and utility (hybrid) type golf club heads.

[0019] The golf club head 1 has a plurality of scorelines 20 formed in its face surface (striking surface) 10. The scorelines 20 are parallel linear grooves extending in the toe-to-heel direction. Also, the face surface 10 has a plurality of fine grooves 30, 31, and 32 formed in it.

[0020] The fine grooves 30 are linear grooves which have a width and depth smaller than the scorelines 20 and extend parallel to the scorelines 20 in the toe-to-heel direction. That the grooves 30 and scorelines 20 are parallel to each other includes a case in which the intersection angle between their infinite extension lines is 0° (inclusive) to 20° (inclusive) for giving an allowance for, for example, manufacturing errors.

[0021] In this embodiment, the plurality of fine grooves 30 are formed to align themselves in a direction d1 perpendicular to the longitudinal direction of the scorelines 20. The fine groove 30 preferably has a length equal to or longer than that of the scoreline 20 nearest to it. Although each fine groove 30 is one continuous groove in this embodiment, some or all of them may be intermittent grooves.

[0022] The fine grooves 31 and 32 have a width and depth smaller than the scorelines 20 and intersect with the fine grooves 30. In this embodiment, the fine grooves 31 and 32 are linear grooves.

[0023] FIG. 2 is a partial sectional perspective view of the face surface 10, FIG. 3A is a sectional view of the scoreline 20 in a direction perpendicular to its longitudinal direction (the toe-to-heel direction), and FIG. 3B is a sectional view of the fine groove 30 taken in a direction perpendicular to its longitudinal direction. The scorelines 20 will be described first.

[0024] In this embodiment, the scorelines 20 are formed at an equal pitch, and have uniform cross-sectional shapes throughout their entire longitudinal portions except for their two ends. Also, the scorelines 20 have the same cross-sectional shape. Moreover, in this embodiment, the cross-sectional shape of the scoreline 20 is symmetrical about the center line in the widthwise direction. Although the cross-sectional shape of the scoreline 20 is a trapezoidal shape in this embodiment, it may be another shape such as a V shape.

[0025] The scoreline 20 has a pair of side walls 21 and a bottom wall 22. An edge 23 of the scoreline 20 is the boundary portion between the side wall 21 and the face surface 10. Although a rounded portion is formed on the edge 23, a configuration in which no rounded portion is formed on the edge 23 can also be adopted.

[0026] The fine grooves **30** are formed to extend parallel to the scorelines **20**, and therefore increase the back spin amount on a struck golf ball. Although the cross-sectional shape of the fine groove **30** is a semicircular shape, as shown in FIG. 3B, in this embodiment, it may be another shape such as a trapezoidal shape or a V shape. A width **W** of the fine groove **30** is preferably, for example, 30 μm (inclusive) to 600 μm (inclusive). The smaller a depth **D** of the fine groove **30**, the smaller the amount of increase in back spin amount, whereas the larger the depth **D**, the more a struck ball is likely to be scratched. Also, the roughness of the face surface of an athletic golf club head has a predetermined limit defined by a maximum height (Ry) of 25 μm or less. Hence, when the golf club head **1** is to be used for athletic purposes, the depth **D** is preferably 5 μm (inclusive) to 25 μm (inclusive).

[0027] The fine grooves **31** and **32** intersect with the fine grooves **30**, and function as water channels for draining water which collects in the fine grooves **30**. Hence, the water having collected in the fine grooves **30** drains into the fine grooves **31** and **32** or drains into another fine groove **30**, in which the water has not yet collected, via the fine grooves **31** and **32**. Upon draining water which collects in the fine grooves **30**, an effect of increasing the back spin amount on a struck golf ball by the fine groove **30** is sustained. This improves an effect of suppressing a decrease in back spin amount in, for example, rainy weather.

[0028] Water which collects in the fine groove **30** flows out and drains into the fine grooves **31** and **32** by means of a pressure generated by a ball at the time of impact. The fine grooves **31** and **32** are preferably vertically formed from the viewpoint of draining water not only by the pressure acting at the time of impact but also by its self weight. Because the fine groove **30** horizontally extend at the time of a shot, the intersection angles between the fine groove **31** and **32** and the fine groove **30** are preferably about 90° and, for example, 75° (inclusive) to 105° (inclusive) from the viewpoint of the drainage performance alone.

[0029] On the other hand, the fine grooves **31** and **32** can not only function as drainage channels but also exhibit a function of increasing the back spin amount on a struck golf ball. As the fine grooves **31** and **32** become more exactly parallel to the fine groove **30**, the back spin amount more greatly increases. Hence, the intersection angles between the fine groove **31** and **32** and the fine groove **30** are preferably about 20° and, for example, 5° (inclusive) to 35° (inclusive) from the viewpoint of the back spin amount alone.

[0030] Considering both the drainage performance and the back spin amount, however, the intersection angles between the fine groove **31** and **32** and the fine groove **30** are preferably 20° (inclusive) to 90° (inclusive).

[0031] In this embodiment, the fine grooves **31** and **32** have different lengths, the fine groove **31** intersects with four fine grooves **30**, and the fine groove **32** intersects with two fine grooves **30**. Although fine grooves of two types: the fine groove **31** and **32** with different lengths are formed as fine grooves which intersect with the fine groove **30** in the foregoing way in this embodiment, fine grooves of one or three or more types may be formed. In either case, each fine groove **30** preferably intersects with at least one fine groove. Also, as in this embodiment, upon making one fine groove **31** and one fine groove **32** intersect with a plurality of fine grooves **30**, the water having collected in the fine groove **30** can drain into another fine groove **30**, in which the water has not yet collected, via the fine groove **31** or **32**, thus enhancing the

drainage efficiency. At least one fine groove which intersects with the fine groove **30** preferably intersects with the plurality of fine grooves **30**.

[0032] The cross-sectional shapes, widths, and depths of the fine grooves **31** and **32** may be the same as or different from those of the fine groove **30**. Especially in accordance with the purpose of use, the fine grooves **31** and **32** can have a depth different from that of the fine groove **30**. For example, when an increase in back spin amount is of prime importance, the fine groove **30** is formed deeper than the fine grooves **31** and **32** to allow a ball to more satisfactorily bite into the face surface **10**. Also, to reduce the difference in back spin amount due to factors associated with water droplets between clear weather and rainy weather, the fine grooves **31** and **32** are formed deeper than the fine groove **30** to enhance the drainage performance.

[0033] In this embodiment, the fine grooves **30** to **32** are formed in the same pattern for each interval between adjacent scorelines **20**. This produces an effect of suppressing the occurrence of a variation in back spin amount depending on the position of a striking point. Note that the roughness of the face surface of an athletic golf club head has a predetermined limit defined by a maximum height (Ry) of 25 μm or less and an arithmetic average roughness of 4.57 μm or less. Hence, when the golf club head **1** is to be used for athletic purposes, the fine grooves **30** to **32** are designed to comply with this surface roughness rule.

[0034] A method of forming scorelines **20** and fine grooves **30** to **32** will be described next. Scorelines **20** can be formed by, for example, forging, molding, cutting, or laser processing. Fine grooves **30** to **32** can be formed by, for example, cutting or laser processing. The fine groove **30** and the fine groove **31** and **32** which intersect with them may be formed by adopting different processing methods.

[0035] A case in which scorelines **20** are formed by forging and fine grooves **30** to **32** are formed by milling will be described herein with reference to FIGS. 4 and 5. FIG. 4 is a sectional view showing a primary shaped product **1'** before fine grooves **30** to **32** are formed, and FIG. 5 is a view for explaining a method of forming fine grooves **30** to **32** by an NC milling machine.

[0036] First, a primary shaped product **1'** of a golf club head **1**, in which scorelines **20** are formed by forging, is fabricated, as shown in FIG. 4. In the primary shaped product **1'**, no fine grooves **30** to **32** are formed in a surface **10'** corresponding to the face surface **10**.

[0037] Next, fine grooves **30** are formed by milling. The primary shaped product **1'** in which no fine groove **30** are formed is fixed to an NC milling machine via a jig **2**, as shown in FIG. 5. Although the face surface **10** is shaped integrally with the golf club head **1** in this embodiment, a face member which forms the face surface **10** and the head body may be provided as separate members and bonded to each other.

[0038] The NC milling machine includes a spindle **4** which is rotationally driven about the Z-axis, and a cutting tool (end mill) **5** attached to the lower end of the spindle **4**. The distal end shape of the cutting tool **5** conforms to the cross-sectional shape of the fine groove **30**.

[0039] After the plane coordinates of the face surface **10** are set on the NC milling machine, the spindle **4** is rotationally driven to cut the face surface **10** while relatively moving the face surface **10** (primary shaped product **1'**) or the cutting tool **5** in the direction to form fine groove **30**. When one fine groove **30** is formed in the face surface **10**, the cutting tool **5**

is separated from the face surface **10**. After that, the cutting tool **5** is relatively moved in the direction in which fine grooves **30** are aligned to form the next fine groove **30**, thereby sequentially forming fine grooves **30**. Fine grooves **31** and **32** can also be formed in the same way.

[0040] When the fine grooves **30** to **32** are formed in the face surface **10**, it is often the case that the face surface **10** becomes more likely to wear out. To prevent this, after the formation of the fine grooves **30** to **32**, a surface treatment for hardening the face surface **10** is preferably performed. Examples of such a surface treatment include carburizing, nitriding, soft nitriding, PVD (Physical Vapor Deposition), ion plating, diamond-like carbon coating, and plating. Especially a surface treatment which modifies a surface without forming another metal layer on the surface, such as carburizing or nitriding, is preferable.

Second Embodiment

[0041] The back spin amount can further be increased by ridging the edge of a fine groove **30**. FIG. 3C is a sectional view of the fine groove **30** in this embodiment. The edge of the fine groove **30** has a ridged portion **30a** formed on it to be ridged, so a ball more satisfactorily bites into the fine groove **30**, thereby making it possible to further increase the back spin amount. For example, when the fine groove **30** is formed by laser processing, the ridged portion **30a** can be spontaneously formed by this processing. Also, when the fine groove **30** is formed by cutting, the ridged portion **30a** can be formed as a burr by relatively coarse cutting.

Third Embodiment

[0042] Fine grooves which intersect with fine grooves **30** may be formed from edges **23** of scorelines **20**. FIG. 6 is a partial sectional perspective view of a face surface **10**, which shows another example of the fine grooves **31**. In the example shown in FIG. 6, fine grooves **31** are formed from the edges **23** of the scorelines **20**. Upon forming the fine grooves **31** from the edges **23**, the scorelines **20** and the fine grooves **31** communicate with each other. Hence, the water in the fine grooves **31** can drain into the scorelines **20**, thereby making it possible to further improve the drainage performance of the fine grooves **30**.

Other Embodiments

[0043] Although a plurality of embodiments of the present invention have been described above, they can be combined with each other, as a matter of course.

[0044] While the present invention has been described with reference to exemplary embodiments, it is to be understood

that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

[0045] This application claims the benefit of Japanese Patent Application No. 2010-105955, filed Apr. 30, 2010, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A golf club head comprising:
a plurality of scorelines are formed in a face surface thereof;
a first fine groove formed in the face surface to extend parallel to the scorelines; and
a second fine groove formed in the face surface to intersect with said first fine groove.
2. The head according to claim 1, wherein
a plurality of said first fine grooves are formed between adjacent scorelines to align themselves in a direction perpendicular to the scorelines,
a plurality of said second fine grooves are formed, and
each of said first fine grooves formed between the adjacent scorelines intersects with at least one of said second fine grooves.
3. The head according to claim 1, wherein
a plurality of said first fine grooves are formed between adjacent scorelines to align themselves in a direction perpendicular to the scorelines,
a plurality of said second fine grooves are formed, and
at least one of said second fine grooves intersects with not less than two of said first fine grooves formed between the adjacent scorelines.
4. The head according to claim 1, wherein said second fine groove is formed from an edge of the scoreline.
5. The head according to claim 1, wherein said first fine groove and said second fine groove are formed by one of cutting and laser processing.
6. The head according to claim 1, wherein said first fine groove has a ridged edge.
7. The head according to claim 1, wherein an intersection angle between said first fine groove and said second fine groove is 20° (inclusive) to 90° (inclusive).
8. The head according to claim 1, wherein said first fine groove and said second fine groove have different depths.
9. The head according to claim 1, wherein depths of said first fine groove and said second fine groove are 5 μm (inclusive) to 25 μm (inclusive).

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