

DESCRIPTION

GOLF CLUB HEAD

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TECHNICAL FIELD

[0001]

The present invention relates to a golf club head which can hit a golf ball with less difference in the carry even if there are differences in the point at which the ball is hit.

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Priority is claimed on Japanese Patent Application No. 2006-212794, filed August 4, 2006, the content of which is incorporated herein by reference.

BACKGROUND ART

[0002]

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Generally speaking, with respect to the golf club known as a “wood”, because of recent requirements or requests of being light and big, there is a tendency in which the thickness of the face that is the hitting area of the club is as thin as possible in order to increase the carry or distance characteristics.

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In such a case, the “sweet spot” (i.e. the ideal location on the hitting area of the club to hit the golf ball) which is an intersection of a perpendicular line from the center of gravity of the golf club head (hereinafter, referred to as the “head”) lead on a surface of the face has a large degree of deformation. Therefore, it is possible to increase the carry or distance of the ball.

[0003]

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With respect to the above-described head, there is a type of head which has a

uniform thickness of the face. By using this type of head, it is possible to obtain a long carry if the ball is hit at the so-called sweet spot. However, the carry or distance is unexpectedly shorter if the ball is hit at a point outside of the sweet spot, and there are significant differences in carry depending on the hitting point. In other words, a head which is formed so as to have a uniform thickness of the face is a type of head which has a smaller ideal hitting area.

[0004]

On the other hand, with respect to the head, in order to increase the coefficient of restitution, it is necessary to maintain a certain level of strength if the thickness of the face is thin. Therefore, there are cases in which a thick portion is provided at a backside of the face (for example, see Japanese Patent Applications, First Publication No. H09-154985(hereinafter, referred to as Patent Document 1) and No. 2006-175135(hereinafter, referred to as Patent Document 2)).

[0005]

The head described in Patent Document 1 has a constitution in which a thick portion extending approximately along the X-axis direction (the horizontal direction) on a backside of the face is provided. The head described in Patent Document 2 has a constitution in which a thick portion in a rib shape extending along the horizontal direction, that is, the direction from the crown side to the sole side on the backside of the face is provided.

[0006]

In accordance with these heads, it is possible to reduce the weight of the head by applying a thin face while maintaining a certain level of strength. Moreover, by applying the head of Patent Document 2, it is possible to further obtain an advantage in which the so-called sweet spot can be extended to the toe and the heel of the hitting area.

[0007]

However, with respect to the head described in Patent Document 1, there is no suggestion of decreased carry or distance when a hitting point is out of the sweet spot.

Therefore, the carry is significantly decreased when the hitting point is outside of the

5 sweet spot. Moreover, with respect to the head described in Patent Document 2, there is a disadvantage in which, if the hitting point is outside of the sweet spot near the crown or the sole, the carry is significantly shorter than the case of hitting the sweet spot.

[0008]

With respect to general golfers, there are cases in which the ball is a bit outside
10 of the sweet spot on impact along various directions including not only the toe and the heel, but also the crown and the sole. When the ball is hit outside of the sweet spot near the crown or the sole, the height of the hitting area can be different with every shot.

Especially if the weight or the center of gravity does not move smoothly during the swing between the return from a backswing and the impact with the ball, there is a very
15 high possibility in which the position of the head will move along the vertical direction against the golf ball. Therefore, it is not sufficient to extend the sweet spot to the toe or heel because it is not possible to fully apply characteristics of the head. If it is possible to keep the difference in carry small even when the hitting point is moved outside of the sweet spot near the crown or sole, it is possible to provide a golf club which can achieve
20 a stable carry for general golfers.

[0009]

With respect to the case of providing a thick portion on the backside of the face, inventors of the present invention have studied various reasons why the carry is decreased at the crown and sole. As a result, the reason why a difference in carry is
25 caused was found which relates to the thicknesses of divided areas formed on a backside

of the face by applying the thick portion.

DISCLOSURE OF INVENTION

[0010]

5 In reference to the above-described background, the present invention has an objective to provide a golf club head appropriate for a golf club which achieves reduction in the difference in carry even if the hitting point moves closer to the crown or sole compared to the case of hitting the sweet spot and which can easily obtain a stable carry.

[0011]

10 In order to achieve the present invention, the following aspects are provided.

 In order to achieve the above-described objects, the present invention may have a constitution in which a golf club head includes: a metal face for hitting a golf ball; a thick portion on a center of a backside of the face extending in a X shape; and four divided areas of the backside of the face divided by the thick portion which have two or
15 more thicknesses.

[0012]

 The above-described golf club head may be a club head in which a maximum difference of thickness of the overall face including the thick portion is 1-5 mm.

[0013]

20 The above-described golf club head may be a club head in which a value obtained by dividing a maximum thickness difference of the overall face including the thick portion by a width of the thick portion is 7.6-62.5%.

[0014]

 The above-described golf club head may have a constitution in which an area
25 of the thick portion is 8.0-18.0% of a total area of the backside of the face.

[0015]

The above-described golf club head may have a constitution in which $(Mca+Msa)/(Mca+Msa+Mta+Mha)$ is 5.4-19.0% when an area of a crown portion is Mca, an area of a sole portion is Msa, an area of a toe portion is Mta, and an area of a heel portion is Mha.

[0016]

In accordance with the above-described aspects of the present invention, because the thick portion extending approximately along the X-axis direction is provided, it is possible to keep the differences in carry small, even if the hitting point is near a toe or a heel compared to the case of hitting the sweet spot. Moreover, even if the hitting point is near the crown or sole, because the thickness of these areas is thinner than thickness of the divided areas of the toe and heel, these areas can be deformed. Therefore, it is possible to prevent a reduction in carry, even if the hitting point is near the crown or sole.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of the face of a golf club head.

FIG. 2 is an outline perspective view of the backside of face.

FIG. 3 is a cross-section of FIG. 2 along a line between A-A and seen from the direction of arrow A.

FIG. 4 is a cross-section of FIG. 2 along a line between B-B and seen from the direction of arrow B.

BEST MODE FOR CARRYING OUT THE INVENTION

[0017]

Hereinafter, referring to drawings, a preferable embodiment of the present invention is explained.

FIG. 1 shows a front view of a face of a golf club head of this embodiment, and FIG. 2 shows an outline perspective view of the face seen from the backside. In these drawings, a head 10 is constituted from a hollow component formed from metal including: a face 11; a toe 12 and a heel 13 which are provided at left and right sides of the face; and a crown 14 and a sole 15 which are provided at upper and lower sides of the face 11. A hosel 17 is provided at an area at which both the crown 14 and the heel 13 cross, and a shaft not shown in the drawings is connected to the hosel 17. The shaft is inserted into the hosel 17 so as to fix the shaft to the head 10. It should be noted that, in examples shown in the drawings, the face 11 is shown as a flat plate for convenience in order to simplify the drawings. In a practical case, the face 11 has a curved shape which is called a bulge.

[0018]

As shown in FIGS. 2-4, on a backside of the face 11, a thick portion 20 in a rib shape which is seen substantially as an X shape on its surface is integrally formed together with the face 11. As shown in the drawings, the thick portion 20 consists of two rib portions, one of them extends in a direction from the crown to the sole and the other rib extends in a direction from the crown to the sole. These two rib portions are crossing and form the X shaped thick portion 20. This thick portion 20 is formed in a state in which a crossing area of the X shape of the thick portion 20 is arranged at a center portion of the face 11. The thick portion 20 is formed in a manner in which a cross-section of the thick portion 20 along a shorter length direction (line between A-A in FIG. 2) has the largest thickness at the center portion like a dome or the shape of a drop of water (see FIG. 3). Moreover, the thick portion 20 is formed in a manner in which a

cross-section of the thick portion 20 along a longer length direction (line between B-B in FIG. 2) has both right and left sides that are comparatively lower. In other words, the thickness of the thick portion 20 gradually decreases along a longer length direction from the center portion to both right and left ends. In the example shown in the drawings, the thick portion 20 is shown in a state in which the straight ribs cross. However, this state is not a limitation to the present invention. It is possible to form a thick portion which includes curved ribs crossing on a plane and which is shown in an X shape.

[0019]

The backside of the face 11 is divided into four portions by providing the thick portion 20, and the four divided surfaces including a crown portion Mc, a sole portion Ms, a toe portion Mt and a heel portion Mh are formed on the backside of the face.

[0020]

Next, in order to check the effects of the present invention, a concrete example is explained by using both a prototype head of the present invention and a comparative head.

[0021]

(Example 1)

In accordance with the 4pcs forging method, four titanium heads were produced which had a head volume of 255cc and a weight of 199g. There were differences among the four heads. However the differences related only to the face structures. Other portions were the same.

First prototype head:

The first prototype head had a center thickness (a center of crossing portion of the thick portion) of 4.80 mm. The crown portion Mc and the sole portion Ms had a thickness of 2.2 mm and the toe portion Mt and the heel portion Mh had a thickness of

2.5 mm. It should be noted that the type of thick portion was selected so that the thickness of the thick portion gradually decreased along a longer length direction from the center portion so as to have a thickness of 3 mm at the both sides of the longer direction. The total area of the backside of the face was 48.2 cm^2 . The ratio of the divided area was as follows. The crown area M_{ca} was 4.6%, the sole area M_{sa} was 7.4%, the toe area M_{ta} was 45.4%, and the heel area M_{ha} was 42.6%.

Comparative head 1:

The comparative head 1 had a face with a uniform thickness of 2.6 mm.

Comparative head 2:

The comparative head 2 had a thick portion which was arranged at the center of the face, which extended along a direction toward the crown and a direction toward the sole and which is formed in an I shape on a surface. The thick portion has a 4.80 mm thickness at the center, and other portions had 2.50 mm thickness.

Comparative head 3:

The comparative head 3 had a thick portion formed in an X shape on a surface which had a 4.80 mm thickness at the center, and similar to the comparative head 2, other portions had 2.50 mm thickness.

[0022]

After connecting shafts to the prototype head 1 and the comparative heads 1-3, tests of carry were conducted by using a robot for test hitting. In the tests, the head speed was 40 m/s, and the average was calculated after hitting 5 balls with each of the heads. As shown in FIG. 1, the hitting points of a golf ball were at the center P1 of the face, points P2/P3 which were substantially horizontally moved respectively to the toe and heel by 20 mm from the center, and the points P4 and P5 which were substantially vertically moved respectively to the crown and sole by 12 mm from the center. Here,

the center P1 of the face was the point of intersection at which two center lines crossed.

The two center lines included: a center line among virtual lines which vertically connected both the boundary between the face and the crown and the boundary between the face and the sole; and a center line among virtual lines which horizontally connected both the boundary between the face and the toe and the boundary between the face and the heel.

The results of the carry obtained at all hitting points of the example 1 are shown below.

[0023]

10 [Table 1]

	20 mm to heel side	center	20 mm to toe side	12 mm to crown side	12 mm to sole side	Maximum difference
Prototype head 1	194 m	201 m	194 m	193 m	193 m	8 m
Comparative head 1	191 m	205 m	191 m	188 m	188 m	17 m
Comparative head 2	194 m	201 m	194 m	186 m	186 m	15 m
Comparative head 3	194 m	201 m	193 m	187 m	187 m	14 m

In accordance with results of Table 1, the prototype head 1 achieved the least difference of carry compared to the center even at the crown portion and the sole portion at which carry was comparatively decreased. This was because, by applying a thinner thickness at the crown and the sole compared to the toe and the heel, it is possible to deform the so-called sweet spot even when the thick portion is provided. Therefore, the prototype head 1 had a larger sweet spot on the surface. By way of parenthesis, it was observed that the prototype head 1 had a coefficient of restitution not larger than 0.83 which is a regulated value with respect to the coefficient of restitution that is scheduled to be enforced from the 2008 fiscal year.

By using the comparative head 1, it was possible to obtain a long carry when the ball was hit at the center. However, the comparative head has large differences of carry if the ball is hit at positions other than the center. Therefore, the comparative head 1 had a small sweet area. Moreover, it was observed that the coefficient of restitution of the comparative head 1 was 0.85, that is, the coefficient of restitution was outside of the regulated value.

Regarding the comparative head 2, it was observed that differences of carry between the toe portion and the center and between the heel portion and the center were small. However, it was observed that differences of carry between the crown portion and the center and between the sole portion and the center were large. Therefore, the sweet area in a vertical direction from the center was still small.

Regarding the comparative head 3, similar to the case of the comparative head 2, it was observed that the sweet area in a vertical direction was small. The reason for such a phenomena is supposed that the thickness of the crown portion and the sole portion was the same as the toe portion and the heel portion.

In accordance with descriptions above, by applying the thick portion in an X shape on the backside surface of the face while the thickness of the areas divided by the thick portion are set as two types, it is supposed that it is possible to obtain a head which has a large sweet area.

[0024]

(Example 2)

Similar to Example 1, in accordance with the 4pcs forging method, three titanium heads were produced which had a head volume of 255cc and a weight of 199g. However, as shown in Table 2 below, the thicknesses of the thick portion and the divided areas were changed from the prototype head 1.

[0025]

[Table 2]

	Heel portion	Center	Toe portion	Crown portion	Sole portion	Difference of thickness
Prototype head 2	2.6 mm	3.4 mm	2.6 mm	2.4 mm	2.4 mm	1.0 mm
Prototype head 3	2.0 mm	6.8 mm	2.0 mm	1.8 mm	1.8 mm	5.0 mm
Prototype head 4	2.6 mm	3.2 mm	2.6 mm	2.4 mm	2.4 mm	0.8 mm

5 [0026]

After connecting shafts to the prototype heads 2-4, in the same manner as Example 1, tests of carry were conducted by using a robot. Test results are shown in Table 3.

[0027]

10 [Table 3]

	20 mm to heel	center	20 mm to toe	12 mm to crown	12 mm to sole	Maximum difference
Prototype head 2	195 m	200 m	196 m	192 m	192 m	8 m
Prototype head 3	197 m	201 m	196 m	194 m	193 m	8 m
Prototype head 4	197 m	205 m	198 m	193 m	193 m	12 m

[0028]

As clearly shown in Table 3, in a case when the difference of thickness inside the face was 1 mm, the maximum difference of carry was 8 m. Moreover, in a case in which the difference of thickness inside the face is 5 mm, the maximum difference of carry was 8 m. Therefore, regarding these two cases, it was understood that head structures achieved large sweet areas. On the other hand, when using the prototype

head 4, it was possible to obtain 12 m of the maximum difference of carry. However, in accordance with the test results, it was observed that it was more effective to apply 1-5 mm to the maximum difference of thickness.

[0029]

5 (Example 3)

Similar to Example 1, in accordance with the 4pcs forging method, four titanium heads were produced. In this example, as shown prototype heads 5-8 in Table 4 below, areas of the thick portions on the backside surfaces of the faces were changed. It should be noted that the prototype head 6 shown in this example corresponds to the

10 above-described prototype head 1.

[Table 4]

	Area of backside of the face	Area of thick portion	Ratio of area of thick portion
Prototype head 5	48.4 cm ²	3.9 cm ²	8.0 %
Prototype head 6 (1)	48.4 cm ²	5.3 cm ²	11.0 %
Prototype head 7	48.4 cm ²	8.7 cm ²	18.0 %
Prototype head 8	48.4 cm ²	12.5 cm ²	25.8 %

[0030]

After connecting shafts to the prototype heads 5-8, in the same manner as Example 1, tests of carry were conducted by using a robot. Carry corresponding to hitting points is shown in Table 5.

[0031]

[Table 5]

	20 mm to heel	center	20 mm to toe	12 mm to crown	12 mm to sole	Maximum difference
Prototype head 5	198 m	203 m	198 m	197 m	196 m	7 m
Prototype head 6	194 m	201 m	194 m	194 m	193 m	8 m
Prototype head 7	191 m	199 m	192 m	191 m	190 m	9 m
Prototype head 8	188 m	196 m	188 m	185 m	184 m	12 m

[0032]

As shown in Table 5 above, by using the prototype head 8, it was possible to make the maximum difference so as to be 12 m or smaller. Moreover, it was observed that it was more effective if the ratio of the area of the thick portion was 18.0% or smaller.

[0033]

(Example 4)

Similar to Example 1, four heads were produced. In this example, as shown in Table 6, the ratio of areas of divided areas was changed. It should be noted that the prototype head 1 described above is included in Table 6 too.

[0034]

[Table 6]

	Ratio of sole portion (A)	Ratio of crown portion (B)	Ratio of heel portion	Ratio of toe portion	(A) + (B)
Prototype head 9	3.2%	2.2%	46.0%	48.6%	5.4%
Prototype head 10(1)	7.4%	4.6%	42.6%	45.4%	12.0%
Prototype head 11	11.7%	7.3%	39.6%	41.4%	19.0%
Prototype head 12	1.9%	1.3%	47.1%	49.7%	3.2%

[0035]

After connecting shafts to the prototype heads, in the same manner as the above-described examples, tests of carry were conducted by using a robot. Test results are shown in Table 7. It should be noted that the prototype head 10 corresponds to the prototype head 1.

[0036]

[Table 7]

	20 mm to heel	Center	20 mm to toe	12 mm to crown	12 mm to sole	Maximum difference
Prototype head 9	195 m	201 m	194 m	193 m	192 m	9 m
Prototype head 10(1)	194 m	201 m	194 m	193 m	193 m	8 m
Prototype head 11	195 m	202 m	194 m	201 m	200 m	8 m
Prototype head 12	195 m	200 m	195 m	188 m	188 m	12 m

[0037]

In accordance with Table 7, regarding the prototype head 12, the ratio of the sole portion and the ratio of the crown portion were relatively small. However, it was observed that the maximum difference of the prototype head 12 was acceptable. Moreover, it was clearly observed that it was further preferable that both the ratio of the sole portion and the ratio of the crown portion should be 5.4% or larger because there is no case of greatly reducing the carry when the ball is hit at the sole portion or the crown portion.

[0038]

(Example 5)

Similar to Example 1, four heads were produced.

In this example, as shown in Table 8, prototype heads 13-16 were made which

had various values R (%) obtained by dividing maximum thickness differences t by widths of thick portions W (see FIG. 1).

After connecting shafts to the prototype heads, tests of carry were conducted by using a robot. Test results are shown in Table 9.

5 [0039]

[Table 8]

	R (%)	W	t
Prototype head 13	12.5%	8.0 mm	1.0 mm
Prototype head 14	62.5%	8.0 mm	5.0 mm
Prototype head 15	2.8%	18 mm	0.5 mm
Prototype head 16	7.6%	13 mm	1.0 mm

[0040]

10 [Table 9]

	20 mm to heel	Center	20 mm to toe	12 mm to crown	12 mm to sole	Maximum difference
Prototype head 13	196 m	202 m	197 m	194 m	194 m	8 m
Prototype head 14	193 m	198 m	193 m	192 m	191 m	7 m
Prototype head 15	198 m	207 m	198 m	195 m	195 m	12 m
Prototype head 16	195 m	201 m	195 m	191 m	191 m	10 m

[0041]

As clearly shown in Table 9, it was possible to obtain the maximum difference so as to be 12 m even when the value $R\%$ was 2.8 %. Moreover, at the center, when the value $R\%$ was 7.6-62.5 %, differences of carry were especially small. Therefore, if $R\%$ is 7.6% or larger, the head has small difference of carry and is preferable.

[0042]

(Example 6)

Similar to Example 1, a prototype head 17 was produced so that the face had a thickness as shown in Table 10.

[0043]

5 [Table 10]

	Heel portion	Center	Toe portion	Crown portion	Sole portion
Prototype head 17	3.0 mm	4.8 mm	2.5 mm	2.0 mm	2.0 mm

[0044]

After connecting a shaft to the prototype head 17, tests of carry were conducted by using a robot. Test results are shown in Table 11.

10 [0045]

[Table 11]

	20 mm to heel side	Center	20 mm to toe side	12 mm to crown side	12 mm to sole side	Maximum difference
Prototype head 17	196 m	201 m	195 m	193 m	193 m	8 m

[0046]

As clearly shown in Table 11, even in a case in which the thickness was arranged so as to be smaller at the toe than the heel and arranged to be smaller at both the crown and the sole than the toe, that is, when three types of thicknesses were included, it was possible to obtain a head which had small differences in carry.

[0047]

A best mode constitution, method, and the like for implementing the present invention are described above. However, the scope of the present invention is not limited by such constitution, method, or the like.

In other words, specific embodiments of the present invention are shown in the

drawings and explained in the above descriptions. However, it is possible for a person of the art to apply various modifications to the above-described embodiments, while remaining within the scope of the present invention. Such modifications are included in the scope of the present invention.

5 [0048]

In the above-described embodiments, for example, a wood club which is called a driver is explained. However, it is possible to apply the above-described embodiments to heads of a fairway wood, utility club, or the like. Moreover, regarding making the differences of carry as small as possible by applying the above-described
10 embodiments, it is also possible to apply the above-described embodiments to an iron club.

Furthermore, there is no limitation such that the thick portion 20 should be integrally constituted together with the face, and the thick portion 20 is an independently formed portion. Therefore, it is possible to attach the thick portion 20 to the backside of
15 the face.

[0049]

Moreover, it is not a limitation in which the thick portion 20 is formed in a manner in which the thickness of the thick portion 20 gradually decreases so as to have both right and left sides which are comparatively lower along a longer length direction
20 from a center portion. However, it is possible to obtain a uniform thickness.

Otherwise, it is possible to form the thick portion 20 so as to have a narrower width along a longer length direction from a center portion to both the right and left ends. In short, the present invention includes at least one feature in which the thick portion made from a rib approximately in an X shape on a surface is provided at the center portion of the face
25 in order to extend the sweet area to both the crown and the heel.

INDUSTRIAL APPLICABILITY

A golf club head appropriate for a golf club is provided which achieves a small difference of carry even if the hitting point moves along directions to a crown or a sole
5 compared to the case of hitting the sweet spot and which can easily obtain a stable carry.

While preferred embodiments of the invention have been described and illustrated above, it should be understood that these are exemplary of the invention and are not to be considered as limiting. Additions, omissions, substitutions, and other modifications can be made without departing from the spirit or scope of the present
10 invention. Accordingly, the invention is not to be considered as being limited by the foregoing description, and is only limited by the scope of the appended claims.

CLAIMS

1. A golf club head comprising:
 - a metal face for hitting a golf ball;
 - a thick portion on a center of a backside of the metal face extending in an X
- 5 shape; and
 - four divided areas of the backside of the metal face divided by the thick portion
 - which have two or more thicknesses.
2. A golf club head according to Claim 1, wherein a maximum difference of
- 10 thickness of the overall metal face including the thick portion is in a range of 1-5 mm.
3. A golf club head according to Claim 1, wherein a value obtained by dividing a
- maximum thickness difference of the overall metal face including the thick portion by a
- width of the thick portion is 7.6-62.5%.
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4. A golf club head according to Claim 1, wherein an area of the thick portion is
- 8.0-18.0% of a total area of the backside of the metal face.
5. A golf club head according to Claim 1, wherein
- 20 $(M_{ca}+M_{sa})/(M_{ca}+M_{sa}+M_{ta}+M_{ha})$ is in a range of 5.4-19.0% when an area of a crown
- portion is M_{ca} , an area of a sole portion is M_{sa} , an area of a toe portion is M_{ta} , and an
- area of a heel portion is M_{ha} .