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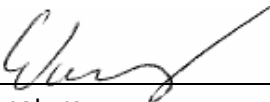
To whom it may concern:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

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Signature

Name

Dr. Warren Smith

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(54) (TITLE OF THE INVENTION)

Method for Manufacturing Iron Head

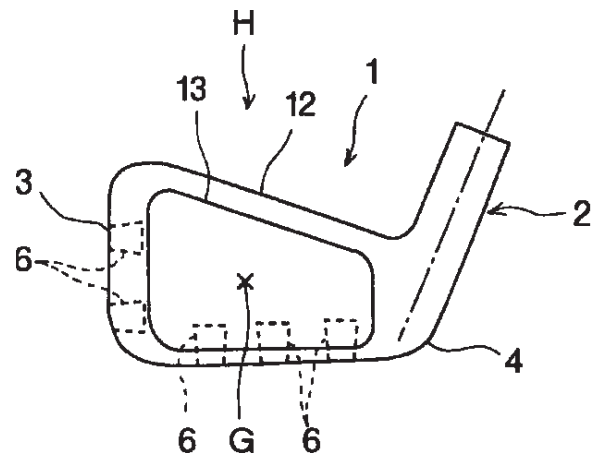
(57) [ABSTRACT]

[PROBLEM]

To achieve easily a movement of center of gravity toward the toe, and a lowering of the center of gravity, without changing the conventional appearance and feeling, in an iron head.

[MEANS FOR RESOLUTION]

A head body portion 1 is structured from a base material portion 12 and a ball-striking surface forming portion 13. Weight members 6, which are tapered so as to thin gradually from an inner end toward an outer end, are formed through powder sintering. The specific gravity of the weight member 6 is no less than 10 g/cm³ and no greater than 22 g/cm³. A plurality of fitting recessed portions is provided in the head body 1, and weight member portions 6 are fitted into the individual fitting recessed portions through pounding. The specific gravity of the weight members 6 is set so as to be greater than the specific gravity of the base material portion 12. The specific gravity of the ball-striking surface forming portion 13 is set so as to be lower than the specific gravity of the base material portion 12.



[PATENT CLAIMS]

[CLAIM 1]

A method for manufacturing an iron head wherein weight members 6, formed through powder sintering, with a specific gravity of no less than 10 g/cm³ and no greater than 22 g/cm³, are formed through powder sintering, fitting recessed portions 7 are formed in at least a toe portion 3 of a head body portion 1, and the weight members 6... are fitted into the fitting recessed portions 7... by pounding or pressing.

[Claim 2]

A method for manufacturing an iron head wherein weight members 6, formed through powder sintering, with a specific gravity of no less than 10 g/cm³ and no greater than 22 g/cm³, are formed through powder sintering, fitting recessed portions 7 are formed in at least a bottom portion 5 of a head body portion 1, and the weight members 6... are fitted into the fitting recessed portions 7... by pounding or pressing.

[CLAIM 3]

A method for manufacturing an iron head wherein weight members 6, formed through powder sintering, with a specific gravity of no less than 10 g/cm³ and no greater than 22 g/cm³, are formed through powder sintering, fitting recessed portions 7 are formed in a toe portion 3 and a bottom portion 5 of a head body portion 1, and the weight members 6... are fitted into the fitting recessed portions 7... by pounding or pressing.

[CLAIM 4]

A method for manufacturing an iron head as set forth in Claim 1, 2, or 3, wherein:

the weight members 6 are formed through powder sintering in a taper that becomes thinner gradually from an inner end 6a toward an outer end.

[CLAIM 5]

A method for manufacturing an iron head as set forth in Claim 4, wherein:

the weight members 6 are formed in a truncated circular cone shape, a truncated quadrilateral pyramid shape, or a truncated pyramid shape that has a cross-sectional star shape.

[CLAIM 6]

A method for manufacturing an iron head as set forth in Claim 1, 2, 3, 4, or 5, wherein:

a head body portion 1 is structured from a base material portion 12 and a ball-striking surface forming portion 13; and

the specific gravity of the weight members 6 is set so as to be greater than the specific gravity of the base material portion 12, and the specific gravity of the ball-striking surface forming portion 13 is set so as to be less than the specific gravity of the base material portion 12.

[CLAIM 7]

A method for manufacturing an iron head as set forth in Claim 1, 2, 3, 4, 5, or 6, wherein a plurality of fitting recessed portions 7... is formed in the head body portion 1, and a weight member 6... is fitted into each of the fitting recessed portions 7...

[DETAILED EXPLANATION OF THE INVENTION]

[0001]

[FIELD OF TECHNOLOGY OF THE INVENTION]

The present invention relates to an iron head of a golf club.

[0002]

[PRIOR ART]

Conventionally, in iron heads of golf clubs, the design has been such that the center of gravity is toward the toe portion, in order to improve the so-called "head returnability," and such that the center of gravity of the head is low, for ease of applying lift when the ball is hit. There are known iron heads, designed in this way, wherein a high specific gravity member is formed through, for example, lost wax casting, a cutting process, die cast forming, or the like, where the high specific gravity members are embedded in the head body portion through press fitting or through insert casting.

[0003]

[PROBLEM SOLVED BY THE PRESENT INVENTION]

However, each individual golfer has a different swing, and thus there is the need for many different varieties, with different iron head masses and different positions for the centers of gravity, in order to accommodate the swings of the individual golfers. Given this, it is most rational and useful to form small high specific gravity members and to vary the number and positions of the individual members.

[0004]

However, there are many disadvantages in processing, as explained below, when forming many small high specific gravity members in a conventional iron head as described above. Specifically, in the case of lost wax casting, first a wax model of all of the members is formed through injection forming, and then the wax models are attached to a tree that is made of wax, following which multiple layers of the slurry are applied, after which baking is performed to cause the wax models to flow out, to create a casting mold, followed by filling with a melted metal, where this complex process has an extremely large number of steps, and is ill-suited for forming a large number of small high specific gravity members for adjusting the weight of the head and the position of the center of gravity. Moreover, when the high specific gravity members are pressed in, the smoother the surfaces of the members, the better, but with lost wax this is controlled by the surface skin of the casting mold, which may be rough. Furthermore, the quality of the product is controlled by how the molten metal flows.

[0005]

Moreover, if the high specific gravity members were formed through a cutting process, the processing would be time-consuming and the processing cost would be high as well, so this would be poorly suited to manufacturing a large number of small high specific gravity members. In particular, when the shape of the high specific gravity members is complex, a cutting process would be difficult, and would not make sense to cut so as to fit with the free surface of the iron head.

[0006]

Moreover, if through diecast forming, cooling would be time-consuming, which would not be suitable for manufacturing a large number of small high specific gravity members. Furthermore, with raw materials that have high melting points or raw materials that are susceptible to oxidation, the forming cost is high, and the process is complex as well.

[0007]

Moreover, while the use of a metal with a high specific gravity, no less than 10 g/cm^3 , is useful in moving the position of the center of gravity within a limited volume, such as in an iron head, the methods described above are unsuitable, in terms of the forming time, cost, and the like, for manufacturing high specific gravity members.

[0008]

Given this, the object of the present invention is to provide a method for manufacturing an iron head that can be manufactured in high volumes at low costs, able to achieve easily a shift of the center of gravity toward the toe, and a shift of the center of gravity downward, while maintaining the conventional appearance and feeling of the head.

[0009]

[MEANS FOR SOLVING THE PROBLEM]

In the method for manufacturing an iron head according to the present invention, in order to achieve the object set forth above, a weight member, formed through powder sintering, with a specific gravity of the less than 10 g/cm^3 and no greater than 22 g/cm^3 is formed through powder sintering, a fitting recessed portion is formed in at least a toe portion of a head body portion, and the weight member is fitted into the fitting recessed portion through pounding or pressing.

[0010]

Moreover, in the method for manufacturing an iron head according to the present invention a weight member, formed through powder sintering, with a specific gravity of the less than 10 g/cm^3 and no greater than 22 g/cm^3 is formed through powder sintering, a fitting recessed portion is formed in at least a bottom portion of a head body portion, and the weight member is fitted into the fitting recessed portion through pounding or pressing.

[0011]

Moreover, in the method for manufacturing an iron head according to the present invention a weight member, formed through powder sintering, with a specific gravity of the less than 10 g/cm^3 and no greater than 22 g/cm^3 is formed through powder sintering, a fitting recessed portion is formed in a toe portion and a bottom portion of a head body portion, and the weight member is fitted into the fitting recessed portion through pounding or pressing.

[0012]

Moreover, the weight member is formed through powder sintering in a taper that becomes thinner gradually from an inner end toward an outer end. In addition, the weight member is formed in a truncated circular column shape, a truncated quadrilateral pyramid shape, or a truncated pyramid shape that has a cross-sectional star shape.

[0013]

Moreover, the head body portion is structured from a base material portion and a ball-striking surface forming portion; and the specific gravity of the weight member is set so as to be greater than the specific gravity of the base material portion, and the specific gravity of the ball-striking surface forming portion is set so as to be less than the specific gravity of the base material portion. Furthermore, a plurality of fitting recessed portions is formed in the head body portion, and a weight member is fitted into each of the fitting recessed portions.

[0014]

[EMBODIMENTS OF THE PRESENT INVENTION]

The present invention will be explained in detail below based on the embodiments in the drawings.

[0015]

FIG. 1, FIG. 2, and FIG. 3 illustrate an iron head obtained through the manufacturing method according to the present invention, wherein 1 is a head body portion and 2 is a neck-in portion, where 3 is a toe portion, 4 is a heel portion, 5 is a bottom portion, and G is the center of gravity of the head.

[0016]

The head body portion 1 of this iron head H is structured from a base material portion 12 and a ball-striking surface forming portion 13. The base material portion 12 is made from the same metal as the material for a typical conventional iron head that is made from a single metal, and may be, for example, soft iron, stainless steel, or the like.

[0017]

Moreover, the specific gravity of the ball-striking surface forming portion 13 is set so as to be less than the specific gravity of the base material portion 12. Note that the material for the ball-striking surface forming portion 13 may be, for example, an aluminum alloy, but other low specific gravity metals (lower than the base material portion 12) may be used freely.

[0018]

Moreover, weight members 6, ... having specific gravities no less than 10 g/cm^3 and no greater than 22 g/cm^3 , formed through powder sintering, are embedded in the toe portion 3 and bottom portion 5 of the head body portion 1. Specifically, a plurality of fitting recessed portions 7, ... is provided in the head body portion 1, and weight members 6 are fitted into each of the fitting recessed portions 7, ... through pounding.

[0019]

As illustrated in FIG. 1, FIG. 2, FIG. 3, and FIG. 4, the weight members 6 are formed as a truncated circular column shape wherein the diameter is reduced gradually from the inner end 6a toward the outer end 6b. That is, the weight member 6 is formed in a taper that is gradually thinner from the inner end 6a toward the outer end 6b. Moreover, the specific gravity of the weight member 6 is set so as to be greater than the specific gravity of the base material portion 12.

[0020]

The fitting recessed portion 7 is provided recessed in a truncated circular cone shape wherein the diameter is reduced gradually from the inner end toward the outer end, having essentially the same inner dimensions as the outer dimensions of the weight member 6.

[0021]

Note that, as illustrated in FIG. 5, the weight member 6 is formed through filling, with metal powder, not shown, the interior of a hollow chamber from an outlet 10 of dies 8 and 9 (where, in the below, this forming method may be termed the "powder sintering method").

[0022]

Moreover, because the weight member 6 is formed through the powder sintering method, as described above, the surface will have good smoothness and dimensional

accuracy. Consequently, the weight member 6 can be pounded easily into the fitting recessed portion 7 from the inner end 6a side that has the large diameter. Moreover, after having been fitted in, the weight member 6 will not come out, even if subjected to a large shock through the impact of a shot.
[0023]

In other words, even if the weight member 6 is embedded in a position that receives repeated large mechanical shocks, such as an iron head, it can exhibit adequate durability. Moreover, this enables an increase in density, and is superior in mechanical strength as well, making it possible to ensure adequate durability as an iron head.
[0024]

Note that insofar as it is a sintered metal with a specific gravity of no less than 10 g/cm^3 and no more than 22 g/cm^3 , the weight member 6 may be of any material, and may be, for example, tungsten, tantalum, lead, molybdenum, gold, silver, platinum, hafnium, an alloy of the above, or the like.
[0025]

Moreover, setting the specific gravity of the ball-striking surface forming portion 13 to be less than the specific gravity of the base material portion 12 is to reduce the amount of increase in weight due to the weight members 6, ..., so as to maintain the total weight and total volume of the iron head H at values that are similar to those of typical conventional iron heads.
[0026]

Moreover, this iron head enables achievement of a movement of the center of gravity toward the toe, and a reduced center of gravity, through embedding the high specific gravity weight members 6, ... in the toe portion 3 and the bottom portion 5. Consequently, the so-called "head returnability" will be good through movement of the center of gravity toward the toe, and the "ease of applying lift to the ball" will be good due to the center of gravity being moved downward.
[0027]

Moreover, as explained in FIG. 5, this can reduce the amount of time required for (sintered metal) manufacturing of the weight members 6, ..., and the amount of work in manufacturing, enabling the weight members 6, ... to be mass-produced at low cost. Moreover, because the weight members 6, ... are interchangeable components (that is, components with identical shapes and identical dimensions), when manufacturing the iron head the "head returnability" and "ease of applying lift," described above, can be adjusted freely through merely adjusting the number and locations of the weight members 6, ... embedded in the head body portion 1.
[0028]

Given this, it is possible to mass-produce, at low cost, a large variety of types of iron heads with different "head returnabilities" and "ease of applying lift." Moreover, iron clubs having "head returnability" and "ease of applying lift" that are optimized to the swings of the individual golfers can be manufactured easily.
[0029]

Note that if the specific gravity of the weight members 6 were less than 10 g/cm^3 , it would be unsuitable, because it would be difficult to adjust the position of the center of

gravity, making it impossible to achieve good "head returnability" and "ease of application of lift." Moreover, in practice it is essentially impossible for the specific gravity of the weight member 6 to be greater than 22 g/cm^3 .
[0030]

Moreover, while, in the embodiment set forth above, weight members 6 were embedded in both the toe portion 3 and the bottom portion 5 of the head body portion of 1, if primarily a shift of the center of gravity toward the toe portion is to be achieved, then the weight members 6 need only be provided in at least the toe portion 3. Of course, the weight members 6, ... may be embedded in the toe portion 3 alone. In this case, the fitting recessed portions 7, ... need only be provided in the toe portion 3 alone in the head body portion 1.
[0031]

Moreover, if primarily a reduction in the center of gravity is to be achieved, then the weight members 6 need only be provided in at least the bottom portion 5. Of course, the weight members 6, ... may be embedded in the bottom portion 5 alone. In this case, the fitting recessed portions 7, ... need only be provided in the bottom portion 5 alone in the head body portion 1.
[0032]

Note that fitting of the weight members 6 into the fitting recessed portions 7 of the head body portion 1 is not only through pounding, but fitting through pressing is also preferred.
[0033]

FIG. 6 (I) and (II) depict other weight members 6, where, in (I) the weight member 6 is formed in a truncated quadrilateral pyramid, and in (II) formed as a truncated pyramid with a cross-sectional star shape. Note that in embedding the weight members 6 into the head body portion 1, the fitting recessed portion 7 should be a truncated quadrilateral pyramid or truncated pyramid with a cross-sectional star shape of a gradually reduced diameter from the inner end toward the outer end, having inner dimensions that are essentially identical to the outer dimensions of the weight member 6.
[0034]

Note that in FIG. 1 through (I) and (II) of FIG. 6, for ease in understanding, the weight member 6, the fitting recessed portion 7, and the hollow chamber 11 of the die 9 are drawn so that the taper shape can be seen, in practice the tapering is extremely slight, with the difference in dimension/edge length between the inner end face and the outer end face being only several hundredths of a millimeter.
[0035]

Moreover, because the weight member 6 is formed through the powder sintering method, described above, the shape may be other than that which is shown in FIG. 4 and (I) and (II) of FIG. 6, where a variety of shapes and sizes can be formed easily and in large quantities.
[0036]

[EMBODIMENTS]

Prototype heads were manufactured next. Specifically, iron heads of Embodiments 1, 2, 3, 4, 5, and 6 were fabricated as shown in Table 1, below.
[0037]

[TABLE 1]

	Weight Member				
	Shape	Position	Number of Weights	Specific Gravity	Material
Embodiment 1	Truncated Circular Cone	Bottom Portion	26	18.4 g/cm ³	Tungsten Alloy
Embodiment 2	Truncated Circular Cone	Toe Portion	11	18.4 g/cm ³	Tungsten Alloy
Embodiment 3	Truncated Quadrilateral Pyramid	Bottom Portion	24	14.0 g/cm ³	Tantalum Alloy
Embodiment 4	Truncated Quadrilateral Pyramid	Toe Portion	9	14.0 g/cm ³	Tantalum Alloy
Embodiment 5	Truncated Star-shaped Pyramid	Bottom Portion	20	11.3 g/cm ³	Lead Alloy
Embodiment 6	Truncated Star-Shaped Pyramid	Toe Portion	8	11.3 g/cm ³	Lead Alloy

[0038]

In Embodiments 1 and 2, the weight members were formed from a tungsten alloy (sintered metal) with a specific gravity of 18.4 g/cm³. The dimensions and shape of the weight members was that of truncated circular cone (referencing FIG. 4) with a diameter of 5.00 mm for the inner end face, a diameter of 4.95 mm for the outer end face, and a height of 5.00 mm (referencing FIG. 4). Moreover, the base material portion of the head body portion was made out of stainless steel, and the ball-striking surface portion was made out of an aluminum alloy.

[0039]

In Embodiments 3 and 4, the weight members were formed from a tantalum alloy (sintered metal) with a specific gravity of 14.0 g/cm³. The dimensions and shape of the weight members were a truncated quadrilateral pyramid with a height of 5.00 mm, where the inner end face was a square with an edge length of 5.00 mm, and the outer end face was a square with an edge length of 4.95 mm (referencing FIG. 6 (I)). Moreover, the base metal portion of the head body portion was made out of soft iron, and the ball-striking surface forming portion was made out of aluminum.

[0040]

In Embodiments 5 and 6, the weight members were formed from a lead alloy (sintered metal) with a specific gravity of 11.3g/cm³. The dimensions and shape of the weight members were a truncated quadrilateral pyramid with a height of 5.00 mm, where the inner end face was a star shape inscribed in a circle with a diameter of 5.00 mm, and the outer end face was a star shape inscribed in a circle with a diameter of 4.95 mm (referencing FIG. 6 (II)). Moreover, the base metal portion of the head body portion was made out of stainless steel, and the ball-striking surface forming portion was made out of aluminum.

[0041]

Note that in Embodiments 1, 2, 3, 4, 5, and 6, the ball-striking surface forming portions being formed from low specific gravity aluminum alloy was to reduce the increase of weight due to the high specific gravity weight members, to maintain total weight and total volume equal to that of a conventional iron head. That is, Embodiments 1, 2, 3, 4, 5, and 6 were formed to have the same total weight and total volume as that of an iron head made from only a single base material alone.

[0042]

The positions of the centers of gravity in the iron heads in Embodiments 1, 2, 3, 4, 5, and 6, described above, were then measured. Note that the position of the center of gravity of an iron head made from only a single base material alone was also measured, as a reference example.

[0043]

Specifically, as illustrated in FIG. 7, two values, the distance M from the axial center of the shaft L of the iron head H to the center of gravity G (the length of the perpendicular line from the center of gravity G downward to the axial center of the shaft L), and the height N of the center of gravity G from the ground surface E when the iron head H is placed on the ground through a loft angle of θ , as illustrated in FIG. 8 (the length of the perpendicular line from the center of gravity G down to the ground surface E), were measured. The measurement results are shown in Table 2 and Table 3, below.

[0044]

[TABLE 2]

	Distance M from the Axial center of the Shaft to the Center of Gravity [of the Club Head]	Difference from Reference Example
Embodiment 1	36.1 mm	0 mm
Embodiment 2	40.6 mm	+4.5 mm
Embodiment 3	36.3 mm	+0.2 mm
Embodiment 4	40.0 mm	+3.9 mm
Embodiment 5	36.0 mm	-0.1 mm
Embodiment 6	39.7 mm	+3.6 mm
Reference Example	36.1 mm	—

[0045]

[TABLE 3]

	Height N of Center of Gravity [of the Club Head] from the Surface of the Earth	Difference from Reference Example
Embodiment 1	17.9 mm	-2.1 mm
Embodiment 2	19.9 mm	-0.1 mm
Embodiment 3	18.1 mm	-1.9 mm
Embodiment 4	20.1 mm	+0.1 mm
Embodiment 5	18.3 mm	-1.7 mm
Embodiment 6	20.0 mm	0 mm
Reference Example	20.0 mm	—

[0046]

From Table 2 and Table 3, above, it can be understood that, when compared to the reference example, Embodiment 1 has the same distance M from the axial center of the shaft to the center of gravity, and the height N of the center of gravity from the earth surface is reduced by 2.1 mm, so the center of gravity is lower.

[0047]

Moreover, when compared to the reference example, in Embodiment 2 the distance M from the axial center of the shaft to the center of gravity is 4.5 mm greater, and the height N of the center of gravity from the Earth surface is reduced by 0.1 mm, and so it is understood that the center of gravity has been shifted toward the toe portion.

[0048]

When compared to the reference example, in Embodiment 3, the distance M from the axial center of the shaft to the center of gravity is increased by 0.2 mm and the height N of the center of gravity from the earth surface is reduced by 1.9 mm, so it is understood that the center of gravity has been lowered.

[0049]

When compared to the reference example, in Embodiment 4, the distance M from the axial center of the shaft to the center of gravity is increased by 3.9 mm and the height N of the center of gravity from the earth surface is increased by 0.1 mm, so it is understood that the center of gravity has been shifted toward the toe.

[0050]

When compared to the reference example, in Embodiment 5, the distance M from the axial center of the shaft to the center of gravity is decreased by 0.1 mm and the height N of the center of gravity from the earth surface is reduced by 1.7 mm, so it is understood that the center of gravity has been lowered.

[0051]

When compared to the reference example, in Embodiment 6, the distance M from the axial center of the shaft to the center of gravity is increased by 3.6 mm and the height N of the center of gravity from the earth surface is the same, so it is understood that the center of gravity has been shifted toward the toe.

[0052]

[EFFECTS OF THE INVENTION]

Through the structure described above, the present invention has large effects as follow:

[0053]

Through the manufacturing method set forth in Claim 1, a significant shift in center of gravity toward the toe can be achieved so as to improve the so-called "head returnability" of an iron. Moreover, a reduction in the center of gravity can be achieved, enabling a good so-called "ease of application of lift when hitting." Moreover, a large variety of different iron heads with different "head returnabilities" and "ease of application of lift when hitting" can be manufactured in large volumes at low costs. Furthermore, iron clubs having "head returnability" and "ease of application of lift when hitting" that are optimized to the swings of individual golfers can be manufactured easily.

[0054]

Through the manufacturing method set forth in Claim 2, a significant reduction in the center of gravity can be achieved so as to improve the so-called "ease of application of lift when hitting" of an iron. Moreover, a shift in the center of gravity for the toe can be achieved, enabling a good so-called "head returnability." Moreover, a large variety of different iron heads with different "ease of application of lift when hitting" and "head returnabilities" can be manufactured in large volumes at low costs. Furthermore, iron clubs having "ease of application of lift when hitting" and "head returnability" that are optimized to the swings of individual golfers can be manufactured easily.

[0055]

Through the manufacturing method set forth in Claim 3, an even greater variety of iron heads with different "head returnabilities" and "ease of applying lift when hitting" can be manufactured in large volumes at low costs. Moreover,

iron clubs having "head returnability" and "ease of application of lift when hitting" that are optimized to the swings of individual golfers can be manufactured even more easily.

[0056]

Through the manufacturing methods set forth in Claim 4 and 5, iron heads can be obtained easily that are able to ensure adequate durability and safety, without the weight members 6 falling out, despite receiving large mechanical shocks through impacts of shots.

[0057]

Through the manufacturing method set forth in Claim 6, iron heads can be manufactured with good "head returnability" and "ease of application of lift when hitting", without a negative effect on appearance or feeling, through maintaining the same total weight and same total volume of a typical conventional iron head. Through Claim 7, iron heads with an even greater variety of different "head returnabilities" and "ease of application of lift when hitting" can be manufactured easily.

[BRIEF DESCRIPTIONS OF THE DRAWINGS]

FIG. 1 is a partial cutaway front view depicting one form of an embodiment according to the present invention.

FIG. 2 is a side view.

FIG. 3 is a front view.

FIG. 4 is a perspective diagram of a weight member.

FIG. 5 is a cross-sectional view of a die for forming a weight member.

FIG. 6 is a perspective diagram illustrating another weight member.

FIG. 7 is an explanatory diagram for the method for measuring the position of the center of gravity.

FIG. 8 is an explanatory diagram for the method for measuring the position of the center of gravity.

[EXPLANATIONS OF REFERENCE SYMBOLS]

1: Head Body Portion

2: Toe Portion

5: Bottom Portion

6: Weight Member

6a: Inner End

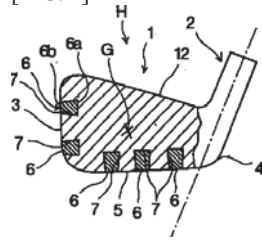
6b: Outer End

7: Fitting Recessed Portion

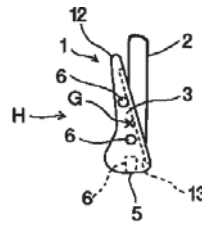
12: Base Material Portion

13: Ball-Striking Surface Forming Portion

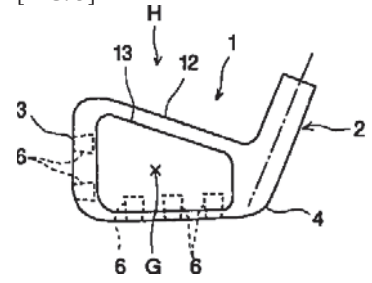
[FIG. 1]



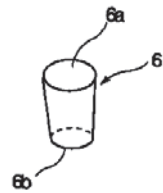
[FIG. 2]



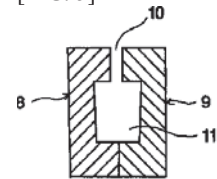
[FIG. 3]



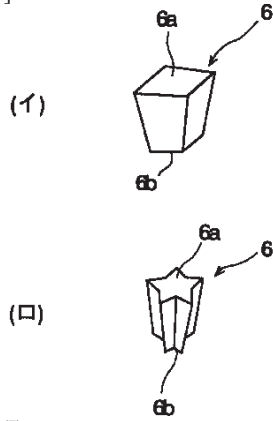
[FIG. 4]



[FIG. 5]

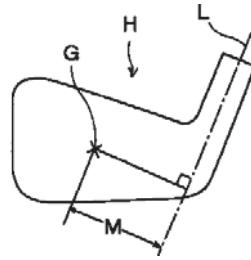


[FIG. 6]

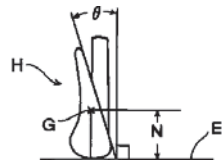


[TOP] (I)
[BOTTOM] (II)

[FIG. 7]



[FIG. 8]



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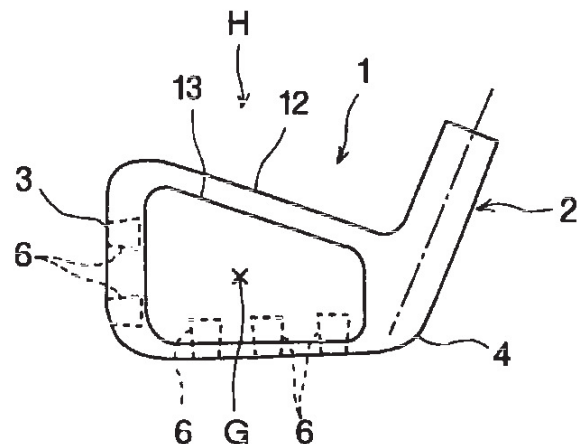
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(54) 【発明の名称】 アイアンヘッドの製造方法

(57) 【要約】

【課題】 アイアンヘッドに於て、従来の見栄えやフィーリングを変えることなく、トウ重心化や低重心化を容易に図ることができるようにする。

【解決手段】 ヘッド本体部1を、基本材質部12と打球面形成部13とから構成する。内端から外端へ次第に縮小するテーパ状のウエイト部材6を、粉末焼結により形成する。ウエイト部材6の比重を 10 g/cm^3 以上かつ 22 g/cm^3 以下とする。ヘッド本体部1に複数の嵌込凹窪部を設け、夫々の嵌込凹窪部に、ウエイト部材6を打撃にて嵌め込む。ウエイト部材6の比重を基本材質部12の比重よりも大きく設定する。打球面形成部13の比重を基本材質部12の比重よりも小さく設定する。



【特許請求の範囲】

【請求項1】 粉末焼結により形成された比重が 10 g/cm^3 以上かつ 22 g/cm^3 以下のウエイト部材6を、粉末焼結により形成し、かつ、ヘッド本体部1の少なくともトウ部3に嵌込凹窪部7を形成し、上記ウエイト部材6…を該嵌込凹窪部7…に、打撃又は圧入によって、嵌め込むことを特徴とするアイアンヘッドの製造方法。

【請求項2】 粉末焼結により形成された比重が 10 g/cm^3 以上かつ 22 g/cm^3 以下のウエイト部材6を、粉末焼結により形成し、かつ、ヘッド本体部1の少なくとも底部5に嵌込凹窪部7を形成し、上記ウエイト部材6…を該嵌込凹窪部7…に、打撃又は圧入によって、嵌め込むことを特徴とするアイアンヘッドの製造方法。

【請求項3】 粉末焼結により形成された比重が 10 g/cm^3 以上かつ 22 g/cm^3 以下のウエイト部材6を、粉末焼結により形成し、かつ、ヘッド本体部1のトウ部3及び底部5に嵌込凹窪部7を形成し、上記ウエイト部材6…を該嵌込凹窪部7…に、打撃又は圧入によって、嵌め込むことを特徴とするアイアンヘッドの製造方法。

【請求項4】 ウエイト部材6を、内端6aから外端へ次第に縮小するテーパ状に、粉末焼結により形成する請求項1、2又は3記載のアイアンヘッドの製造方法。

【請求項5】 ウエイト部材6を、円錐台状、四角錐台状又は断面星型錐台状に形成する請求項4記載のアイアンヘッドの製造方法。

【請求項6】 ヘッド本体部1を、基本材質部12と打球面形成部13とから構成して、かつ、ウエイト部材6の比重を上記基本材質部12の比重よりも大きく設定し、さらに、上記打球面形成部13の比重を上記基本材質部12の比重よりも小さく設定した請求項1、2、3、4又は5記載のアイアンヘッドの製造方法。

【請求項7】 ヘッド本体部1に複数の嵌込凹窪部7…を形成して、各々の該嵌込凹窪部7…に、ウエイト部材6…を嵌め込む請求項1、2、3、4、5又は6記載のアイアンヘッドの製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、ゴルフクラブのアイアンヘッドに関する。

【0002】

【従来の技術】ゴルフクラブのアイアンヘッドに於て、いわゆる「ヘッドの返り易さ」を良くするために重心をトウ寄りに設計することや、打球を上がり易くするために、ヘッドの重心を低く設計することは、従来から行われている。そのような設計の施されたアイアンヘッドとしては、例えば、ロストワックス鑄造、切削加工、及び、ダイカスト成形等により、高比重部材を成形して、その高比重部材を、圧入や鑄ぐるみ等にて、ヘッド本体部に埋め込んだものが、公知であった。

【0003】

【発明が解決しようとする課題】ところで、ゴルフプレーヤーのスイングは千差万別で、個々人のスイングに対応するようにアイアンヘッドの重量や重心位置を相違させた数多くのタイプが必要である。それには、小さな高比重部材を形成し、その部材の個数と配置を変えることが、最も合理的かつ有利である。

【0004】しかしながら前述のような従来のアイアンヘッドでは、小さな高比重部材を数多く作るには、以下に説明するように、工程上不利な点が多い。即ち、ロストワックス鑄造による場合、まずインジェクション成形により全ての部材のワックスモデルを製作し、それをワックス製のツリーに取付け、次いで複数層数スラリーをまぶして、その後、焼成してワックスモデルを流し出すと共に鑄型を作成し、次いで、溶解金属を流し込むという複雑な工程をとるため、非常に工程数が多くヘッドの重量、重心位置調整用の小品多数の高比重部材の成形には不適である。さらに、その高比重部材を圧入する場合、部材の表面は滑らかな方が良いが、ロストワックスでは、鑄型の表面肌を左右され荒れることもある。さらに、溶解金属の流れかたに製品の質が左右されてしまう。

【0005】また、高比重部材を切削加工により成形する場合、加工に時間がかかると共に加工コストも高くなるため、小品多数の高比重部材の製作には不適である。特に、高比重部材の形状が複雑な場合は、切削加工が困難であり、アイアンヘッドの自由局面に適合するように切削することは非合理的である。

【0006】また、ダイカスト成形による場合、冷却に時間がかかるため、小品多数の高比重部材の製作には不適である。さらに、融点の高い素材や酸化しやすい素材では、成形コストがかかり工程も複雑化し困難である。

【0007】また、アイアンヘッドのように限られた体積の中で重心位置を動かすには 10 g/cm^3 以上の比重の高い金属を用いる方が有利であるが、上述のような方法では、そのような高比重の部材を製作するには成形時間、コスト等の面で不適であった。

【0008】そこで、本発明は、従来のヘッドの見栄えやフィーリングを保持したまま、容易にトウ重心化や低重心化を図ることができ、かつ、低コストにて大量に生産できるアイアンヘッドの製造方法を提供することを目的とする。

【0009】

【課題を解決するための手段】上述の目的を達成するために本発明に係るアイアンヘッドの製造方法は、粉末焼結により形成された比重が 10 g/cm^3 以上かつ 22 g/cm^3 以下のウエイト部材を、粉末焼結により形成し、かつ、ヘッド本体部の少なくともトウ部に嵌込凹窪部を形成し、上記ウエイト部材を該嵌込凹窪部に、打撃又は圧入によって、嵌め込む方法である。

【0010】また、本発明に係るアイアンヘッドの製造

方法は、粉末焼結により形成された比重が 10 g/cm^3 以上かつ 22 g/cm^3 以下のウエイト部材を、粉末焼結により形成し、かつ、ヘッド本体部の少なくとも底部に嵌込凹窪部を形成し、上記ウエイト部材を該嵌込凹窪部に、打撃又は圧入によって、嵌め込む方法である。

【0011】あるいは、本発明に係るアイアンヘッドの製造方法は、粉末焼結により形成された比重が 10 g/cm^3 以上かつ 22 g/cm^3 以下のウエイト部材を、粉末焼結により形成し、かつ、ヘッド本体部のトウ部及び底部に嵌込凹窪部を形成し、上記ウエイト部材を該嵌込凹窪部に、打撃又は圧入によって、嵌め込む方法である。

【0012】また、ウエイト部材を、内端から外端へ次第に縮小するテーパ状に、粉末焼結により形成する。そして、ウエイト部材を、円錐台状、四角錐台状又は断面星型錐台状に形成する。

【0013】また、ヘッド本体部を、基本材質部と打球面形成部とから構成して、かつ、ウエイト部材の比重を上記基本材質部の比重よりも大きく設定し、さらに、上記打球面形成部の比重を上記基本材質部の比重よりも小さく設定したものである。そして、ヘッド本体部に複数の嵌込凹窪部を形成して、各々の該嵌込凹窪部に、ウエイト部材を嵌め込む。

【0014】

【発明の実施の形態】以下、図示の実施の形態に基づき本発明を詳説する。

【0015】図1と図2と図3は本発明に係る製造方法によって得られたアイアンヘッドを示し、1はヘッド本体部、2はネック部であり、3はトウ部、4はヒール部、5は底部、Gはこのヘッドの重心である。

【0016】このアイアンヘッドHのヘッド本体部1は、基本材質部12と打球面形成部13とから構成されている。基本材質部12は、単一の金属からなる従来の一般的なアイアンヘッドの材質と同様の金属から成り、例えば、軟鉄やステンレス等が挙げられる。

【0017】また、打球面形成部13の比重は、基本材質部12の比重よりも小さく設定されている。なお、打球面形成部13の材質としては、例えば、アルミ合金が挙げられるが、それ以外の（基本材質部12よりも）低比重の金属を用いるも自由である。

【0018】しかして、ヘッド本体部1のトウ部3と底部5に、粉末焼結により形成された比重が 10 g/cm^3 以上かつ 22 g/cm^3 以下のウエイト部材6…を、埋設する。具体的には、ヘッド本体部1に複数の嵌込凹窪部7…を設け、夫々の嵌込凹窪部7…に、ウエイト部材6…を打撃にて嵌め込む。

【0019】ウエイト部材6は、図1と図2と図3と図4に示すように、内端6aから外端6bへ次第に縮径する円錐台状に形成される。つまり、ウエイト部材6は、内端6aから外端6bへ次第に縮小するテーパ状に形成される。また、ウエイト部材6の比重は、基本材質部12

の比重よりも大きく設定される。

【0020】嵌込凹窪部7は、ウエイト部材6の外寸法と略同一の内寸法を有する内端から外端へ次第に縮径する円錐台状として凹設される。

【0021】ところで、ウエイト部材6は、図5に示すように、金型8、9の射出口10から中空室11内に図示省略の粉末金属を充填して加熱加圧することにより、形成される（以下この形成方法を粉末焼結法と呼ぶことがある）。

【0022】上記の如く、ウエイト部材6は、粉末焼結法にて形成されるので、表面の滑らかさと寸法精度に優れている。従って、ウエイト部材6を、径寸法が大きな内端6a側から嵌込凹窪部7へ打撃にて嵌め込み易い。かつ、一旦嵌め込んだ後は、ショットの際のインパクトによる大きな衝撃を受けてもウエイト部材6が抜けることは無い。

【0023】これを言い換えれば、アイアンヘッドのように繰り返し大きな衝撃を受ける部位にウエイト部材6を埋設しても、十分な耐久性を発揮できる。また、高密度化が可能で器械的強度にも優れており、アイアンヘッドとして十分な耐久性を確保できる。

【0024】なお、ウエイト部材6は、比重が 10 g/cm^3 以上かつ 22 g/cm^3 以下の焼結金属であれば材質は問わず、例えば、タングステン、タンタル、鉛、モリブデン、金、銀、白金、ハフニウム、あるいは、それらの合金などが挙げられる。

【0025】また、打球面形成部13の比重を、基本材質部12の比重よりも小さく設定したのは、ウエイト部材6…による重量増加分を減らして、このアイアンヘッドHの総重量と総体積を、従来の一般的なアイアンヘッドと同様の値に保つためである。

【0026】しかして、このアイアンヘッドによれば、高比重のウエイト部材6…をトウ部3と底部5に埋設したことにより、トウ重心化と低重心化を図ることができる。従って、トウ重心化により、いわゆる「ヘッドの返り易さ」が良くなり、かつ、低重心化により「打球の上がり易さ」が良くなる。

【0027】また、図5にて説明したように、ウエイト部材6…（焼結金属）の製造に要する時間及び製造工数を低減でき、ウエイト部材6…を低コストで量産できる。さらに、ウエイト部材6…は共通部品（同一形状かつ同一寸法）であるため、このアイアンヘッドを製造する際に、ヘッド本体部1に埋設するウエイト部材6…の位置や個数を変更するのみで、上記「ヘッドの返り易さ」と「打球の上がり易さ」を自由に調整することができる。

【0028】従って、「ヘッドの返り易さ」と「打球の上がり易さ」が相違する多くのタイプのアイアンヘッドを、低コストで大量に製造することができる。かつ、ゴルファーの個々人のスイングに最も適した「ヘッドの返

り易さ」と「打球の上がり易さ」を有するアイアンクラブを、容易に製造できる。

【0029】なお、ウエイト部材6の比重を $10\text{g}/\text{cm}^3$ 未満とすると、重心位置を変化させることが困難であり、「ヘッドの返り易さ」や「打球の上がり易さ」を良くすることができないため、不適である。また、ウエイト部材6の比重を $22\text{g}/\text{cm}^3$ よりも大きくすることは、事実上ほとんど不可能である。

【0030】また、上述の実施の形態では、ヘッド本体部1のトウ部3と底部5の両方に、ウエイト部材6…が埋設されているが、主としてトウ重心化を図る場合は、少なくともトウ部3にウエイト部材6…を配設すればよい。勿論、トウ部3にのみウエイト部材6…を埋設するも自由である。その場合は、ヘッド本体部1のトウ部3にのみ嵌込凹窪部7…を設ければよい。

【0031】また、主として低重心化を図る場合は、少なくとも底部5にウエイト部材6…を配設すればよい。勿論、底部5にのみウエイト部材6…を埋設するも自由である。その場合は、ヘッド本体部1の底部5にのみ嵌込凹窪部7…を設ければよい。

【0032】なお、ウエイト部材6をヘッド本体部1の嵌込凹窪部7に、打撃にて嵌め込むのみならず、圧入にて嵌め込むのも好ましい。

【0033】次に、図6の(イ)(ロ)は、他のウエイト部材6を示し、(イ)は、四角錐台として形成され、(ロ)は断面星型錐台として形成されている。なお、これらのウエイト部材6をヘッド本体部1に埋設するには、嵌込凹窪部7を、ウエイト部材6の外形寸法と略同一の内形寸法を有する内端から外端へ次第に縮径する四角錐台又は断面星型の錐台とすればよい。

【0034】なお、図1～図6の(イ)(ロ)は、理解し易くするために、ウエイト部材6と嵌込凹窪部7と金型9の中空室11を、目視にてテーパ形状と分かるように描いてあるが、実際は、内端面と外端面の径寸法・一辺の長さ等の差が百分の数mm程度の微妙なテーパ状とされる。

【0035】また、ウエイト部材6は前述の粉末焼結法にて形成されるので、図4と図6の(イ)(ロ)に示した形状のもの以外にも、種々の形状及び大きさのものを、容易かつ大量に形成できる。

【0036】

【実施例】次に、試作ヘッドを作成した。具体的には、次の表1に示すように、実施例1, 2, 3, 4, 5, 6のアイアンヘッドを作成した。

【0037】

【表1】

	ウエイト部材				
	形状	位置	個数	比重	材質
実施例1	円錐台	底部	26個	$18.4\text{g}/\text{cm}^3$	タングステン合金
実施例2	円錐台	トウ部	11個	$18.4\text{g}/\text{cm}^3$	タングステン合金
実施例3	四角錐台	底部	24個	$14.0\text{g}/\text{cm}^3$	タンタル合金
実施例4	四角錐台	トウ部	9個	$14.0\text{g}/\text{cm}^3$	タンタル合金
実施例5	星型錐台	底部	20個	$11.3\text{g}/\text{cm}^3$	鉛合金
実施例6	星型錐台	トウ部	8個	$11.3\text{g}/\text{cm}^3$	鉛合金

【0038】実施例1, 2は、ウエイト部材を、比重 $18.4\text{g}/\text{cm}^3$ のタングステン合金（焼結金属）にて形成した。そのウエイト部材の寸法・形状は、内端面の直径が 5.00mm 、かつ、外端面の直径が 4.95mm 、かつ、高さが 5.00mm の円錐台とした（図4参照）。また、ヘッド本体部の基本材質部をステンレス製とし、打球面形成部をアルミ合金製とした。

【0039】実施例3, 4では、ウエイト部材を、比重 $14.0\text{g}/\text{cm}^3$ のタンタル合金（焼結金属）にて形成した。そのウエイト部材の寸法・形状は、内端面が一辺の長さ 5.00mm の正方形、かつ、外端面が一辺の長さ 4.95mm の正方形、かつ、高さが 5.00mm の四角錐台とした（図6の(イ)参照）。また、ヘッド本体部の基本材質部を軟鉄製とし、打球面形成部をアルミ合金製とした。

【0040】実施例5, 6では、ウエイト部材を、比重

$11.3\text{g}/\text{cm}^3$ の鉛合金（焼結金属）にて形成した。そのウエイト部材の寸法・形状は、内端面が直径 5.00mm の円に内接する星型、かつ、外端面が直径 4.95mm の円に内接する星型、かつ、高さが 5.00mm の四角錐台とした（図6の(ロ)参照）。また、ヘッド本体部の基本材質部をステンレス製とし、打球面形成部をアルミ合金製とした。

【0041】なお、実施例1, 2, 3, 4, 5, 6に於て、打球面形成部を低比重のアルミ合金にて形成したのは、高比重のウエイト部材による重量増加分を減らして従来のアイアンヘッドと同等の総重量と総体積を保つためである。つまり、実施例1, 2, 3, 4, 5, 6を、単一の基本材質のみから成るアイアンヘッドと同じ総重量かつ同じ総体積となるように、形成した。

【0042】次に、上記実施例1, 2, 3, 4, 5, 6のアイアンヘッドの重心位置を測定した。なお、比較例

として、単一の基本材質のみから成るアイアンヘッドの重心位置も測定した。

【0043】具体的には、図7に示すように、アイアンヘッドHのシャフト軸心Lから重心Gまでの距離M（重心Gからシャフト軸心Lに下ろした垂線の長さ）と、図8に示すように、アイアンヘッドHをロフト角 θ 通りに

接地させたときの地面Eからの重心Gの高さN（重心Gから地面Eに下ろした垂線の長さ）との、2つの値を測定した。その測定結果を次の表2と表3に示す。

【0044】

【表2】

	シャフト軸心から 重心までの距離M	比較例との差
実施例1	36.1mm	0 mm
実施例2	40.6mm	+4.5mm
実施例3	36.3mm	+0.2mm
実施例4	40.0mm	+3.9mm
実施例5	36.0mm	-0.1mm
実施例6	39.7mm	+3.6mm
比較例	36.1mm	—

【0045】

【表3】

	地面からの重心高さN	比較例との差
実施例1	17.9mm	-2.1mm
実施例2	19.9mm	-0.1mm
実施例3	18.1mm	-1.9mm
実施例4	20.1mm	+0.1mm
実施例5	18.3mm	-1.7mm
実施例6	20.0mm	0 mm
比較例	20.0mm	—

【0046】上記表2と表3より、実施例1は、比較例に比して、シャフト軸心から重心までの距離Mは同一であり、かつ、地面からの重心高さNが、2.1mm小さくなっていることから、低重心となっていることが分かる。

【0047】また、実施例2は、比較例に比して、シャフト軸心から重心までの距離Mが4.5mm大きくなっており、かつ、地面からの重心高さNが、0.1mm小さくなっていることから、トウ重心化されていることが分かる。

【0048】実施例3は、比較例に比して、シャフト軸心から重心までの距離Mが0.2mm大きくなっており、かつ、地面からの重心高さNが、1.9mm小さくなっていることから、低重心となっていることが分かる。

【0049】実施例4は、比較例に比して、シャフト軸心から重心までの距離Mが3.9mm大きくなっており、かつ、地面からの重心高さNが、0.1mm大きくなっていることから、トウ重心化されていることが分かる。

【0050】実施例5は、比較例に比して、シャフト軸心から重心までの距離Mが0.1mm小さくなっており、か

つ、地面からの重心高さNが、1.7mm小さくなっていることから、低重心となっていることが分かる。

【0051】実施例6は、比較例に比して、シャフト軸心から重心までの距離Mが3.6mm大きくなっており、かつ、地面からの重心高さNが同一であることから、トウ重心化されていることが分かる。

【0052】

【発明の効果】本発明は上述の構成により、次のような著大な効果を奏する。

【0053】請求項1記載の製造方法によれば、アイアンに於ていわゆる「ヘッドの返り易さ」が良くなるように十分に有意なトウ重心化を図ることができる。さらに、低重心化も図ることができ、いわゆる「打球の上がり易さ」を良くすることが可能である。また、「ヘッドの返り易さ」と「打球の上がり易さ」が相違する多くのタイプのアイアンヘッドを、大量かつ低コストにて製造することができる。かつ、ゴルファーの個々人のスイングに最も適した「ヘッドの返り易さ」と「打球の上がり

易さ」を有するアイアンクラブを、容易に製造できる。

【0054】請求項2記載の製造方法によれば、アイアンに於ていわゆる「打球の上がり易さ」が良くなるように十分に有意な低重心化を図ることができる。さらに、トウ重心化も図ることができ、いわゆる「ヘッドの返り易さ」を良くすることが可能である。また、「打球の上がり易さ」と「ヘッドの返り易さ」が相違する多くのタイプのアイアンヘッドを、大量かつ低コストにて製造することができる。かつ、ゴルファーの個々人のスイングに最も適した「打球の上がり易さ」と「ヘッドの返り易さ」を有するアイアンクラブを、容易に製造できる。

【0055】請求項3記載の製造方法によれば、「ヘッドの返り易さ」と「打球の上がり易さ」が相違する、一層多種多様のアイアンヘッドを、大量かつ低コストにて製造することができる。さらに、ゴルファーの個々人のスイングに最も適した「ヘッドの返り易さ」と「打球の上がり易さ」を有するアイアンクラブを、一層容易に製造可能となる。

【0056】請求項4、5記載の製造方法によれば、ショットのインパクトによる大きな衝撃を受けてもウエイト部材6が抜け落ちることが無く、十分な耐久性と安全性を確保できるアイアンヘッドが容易に得られる。

【0057】請求項6記載の製造方法によれば、従来の一般的なアイアンヘッドと同様の総重量及び同様の総体積を保持させて、見栄えやフィーリングを損ねること無

く、「ヘッドの返り易さ」と「打球の上がり易さ」を良くしたアイアンヘッドを、製造できる。請求項7によれば、アイアンヘッドの「ヘッドの返り易さ」と「打球の上がり易さ」が異なる、一層多くのタイプのものが、容易に製造可能となる。

【図面の簡単な説明】

【図1】本発明の実施の一形態を示す一部破断した正面図である。

【図2】側面図である。

【図3】正面図である。

【図4】ウエイト部材の斜視図である。

【図5】ウエイト部材形成用の金型の断面図である。

【図6】他のウエイト部材を示す斜視図である。

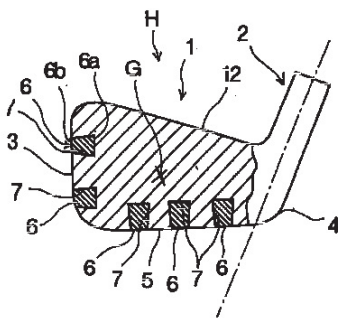
【図7】重心位置測定方法説明図である。

【図8】重心位置測定方法説明図である。

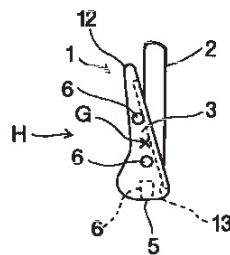
【符号の説明】

- 1 ヘッド本体部
- 3 トウ部
- 5 底部
- 6 ウエイト部材
- 6a 内端
- 6b 外端
- 7 嵌込凹窪部
- 12 基本材質部
- 13 打球面形成部

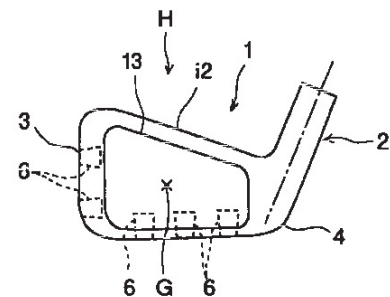
【図1】



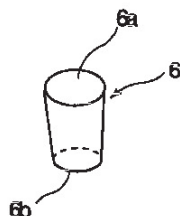
【図2】



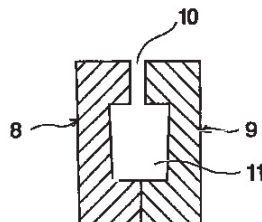
【図3】



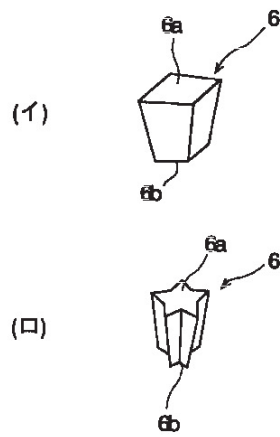
【図4】



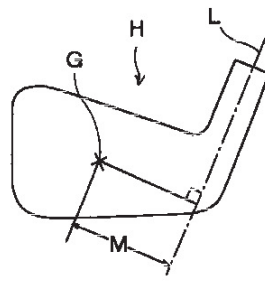
【図5】



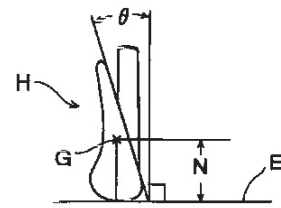
【図6】



【図7】



【図8】



フロントページの続き

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