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(54) GOLF CLUB HEAD

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(57) ABSTRACT

This invention provides a golf club head to which a damping member is attached. The damping member is formed by combining a plurality of materials including at least a resin material and a damping alloy. Alternatively, the damping member is formed by combining a plurality of materials including at least a resin material and a magnetic material.

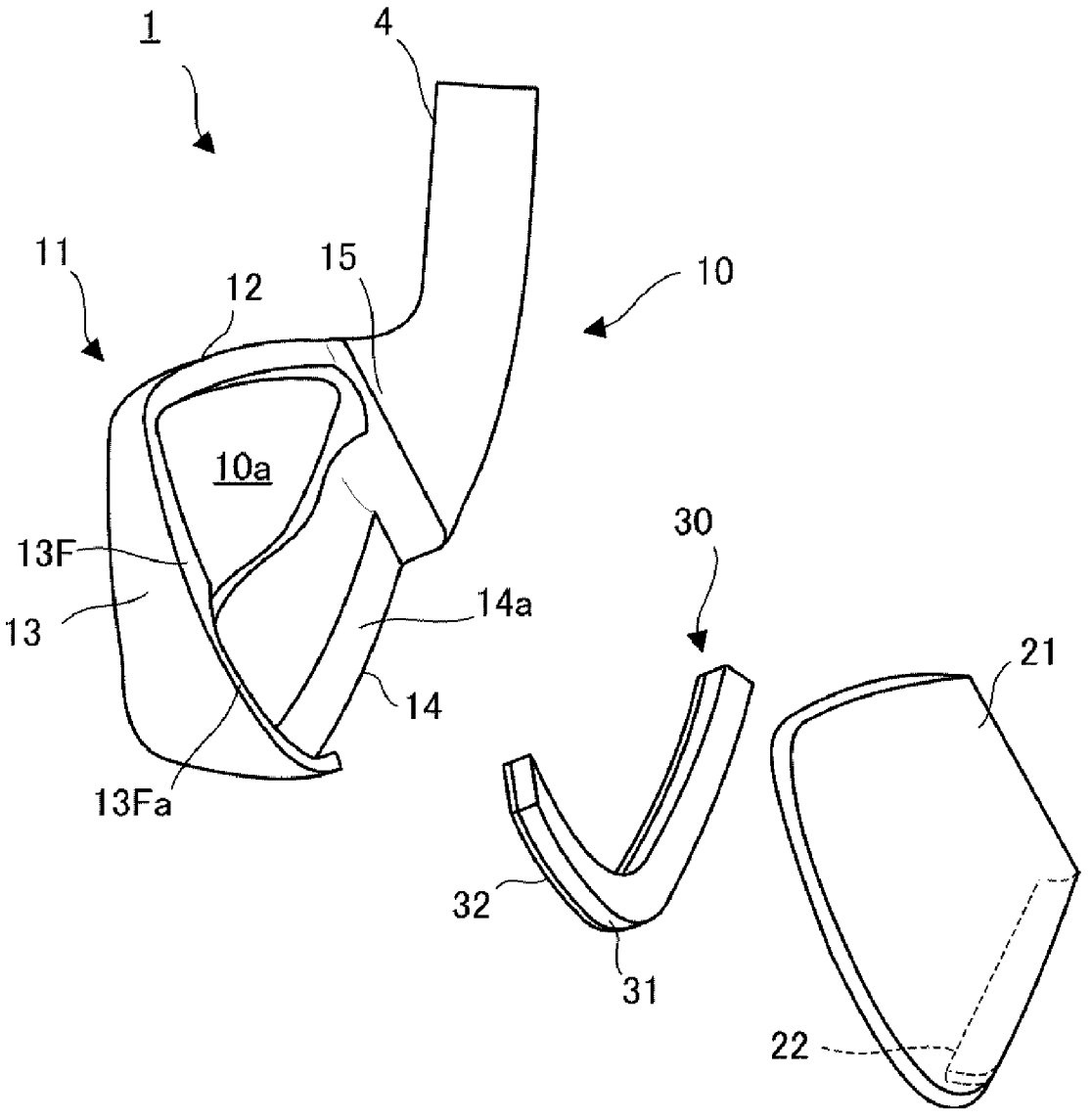


FIG. 1

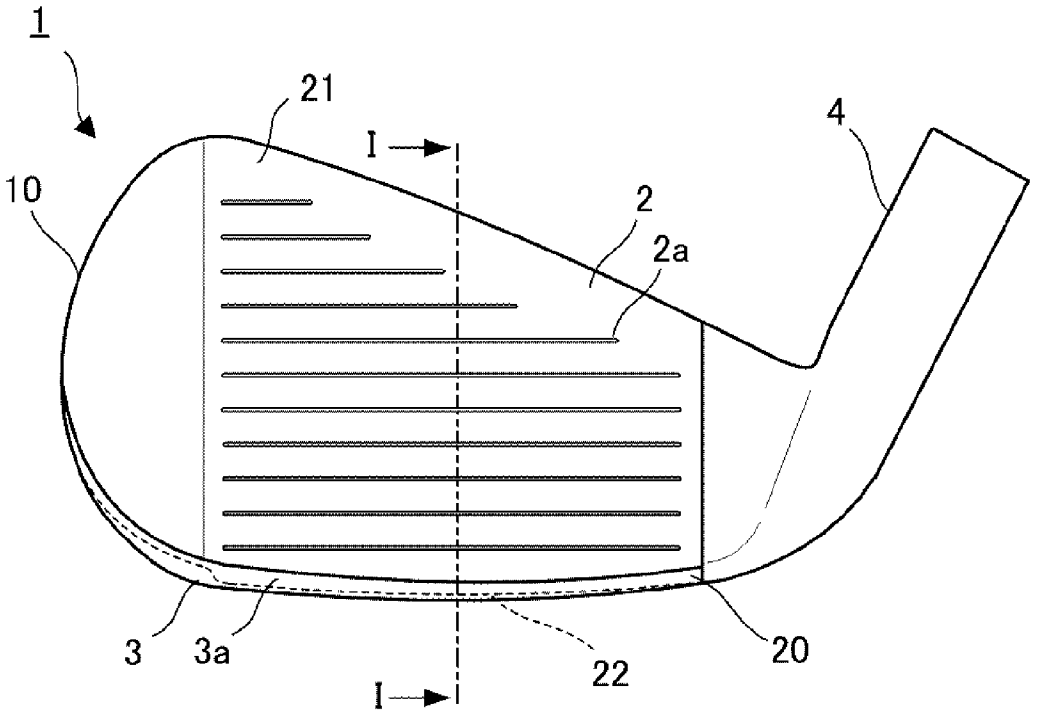


FIG. 2A

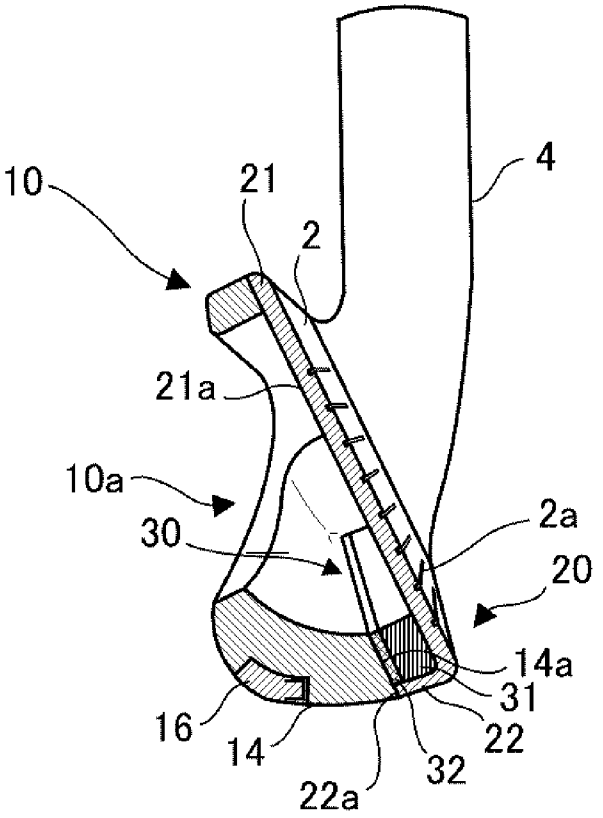

10
21
2
4
21a
10a
30
2a
20
14a
31
16
14
22
22a
32

FIG. 2B

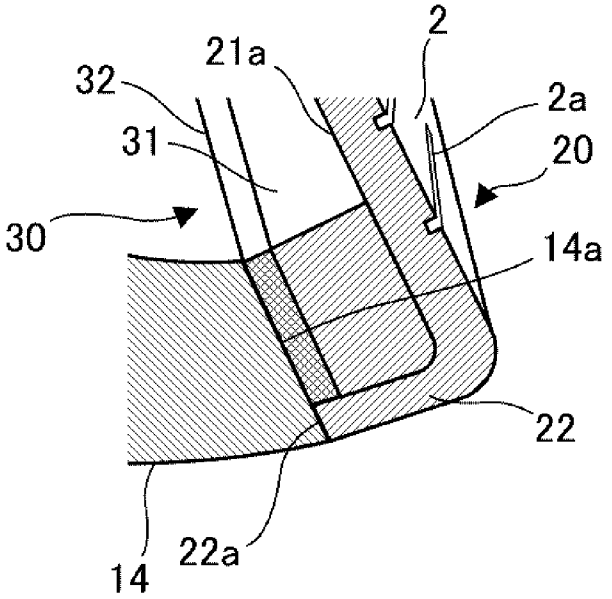
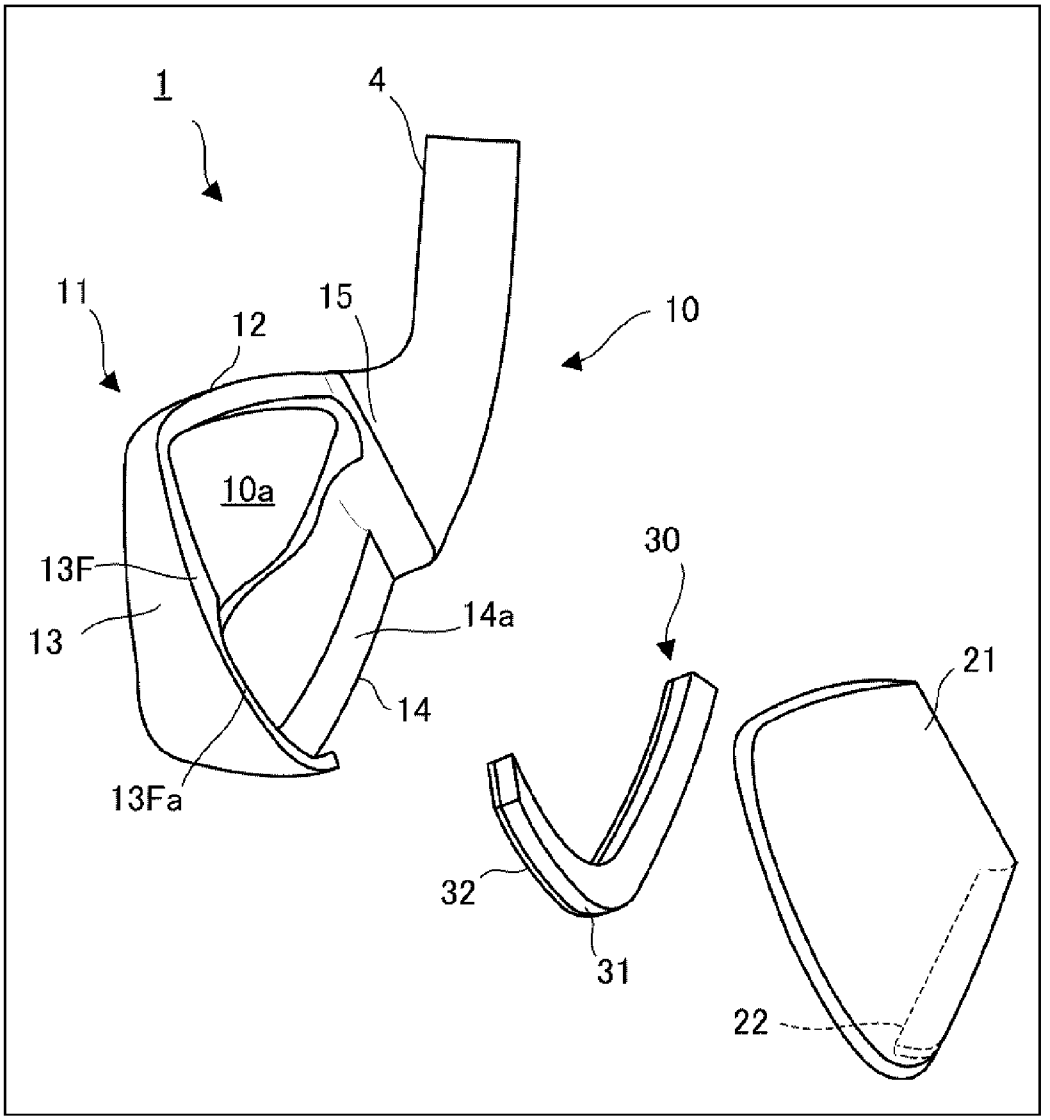

2
21a
32
2a
31
20
30
14a
22
14
22a

FIG. 3



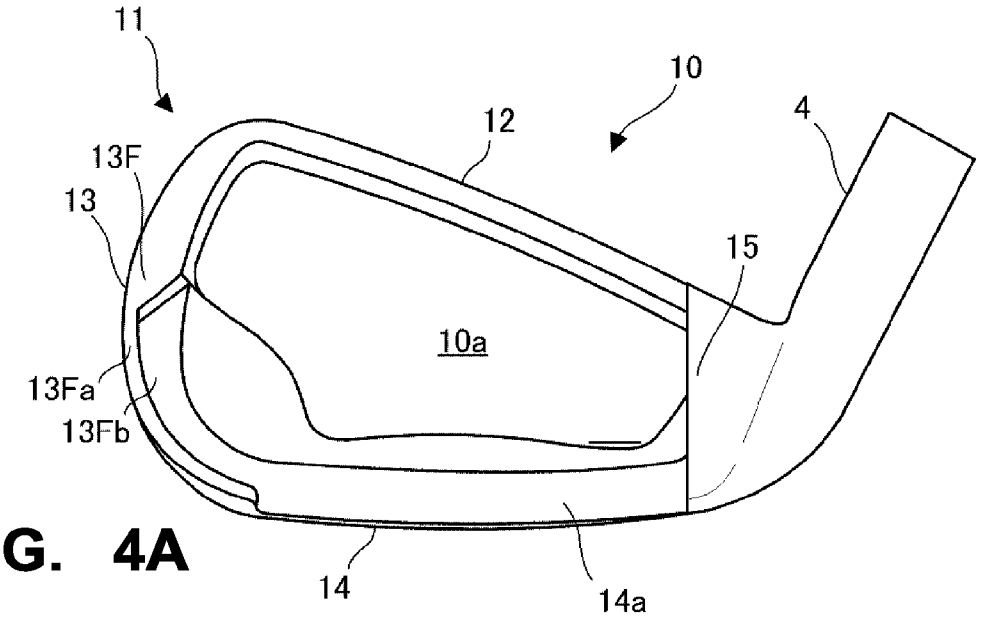


FIG. 4A

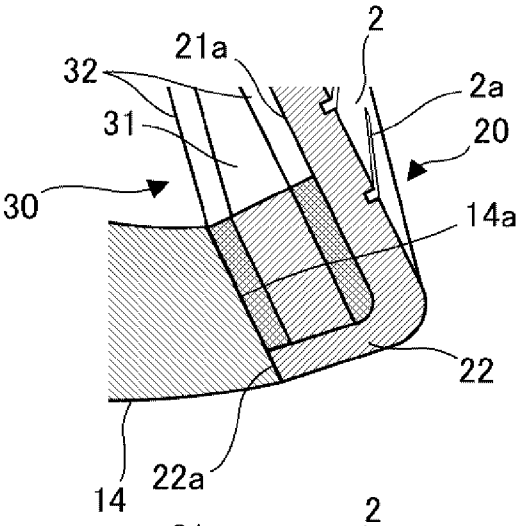


FIG. 4B

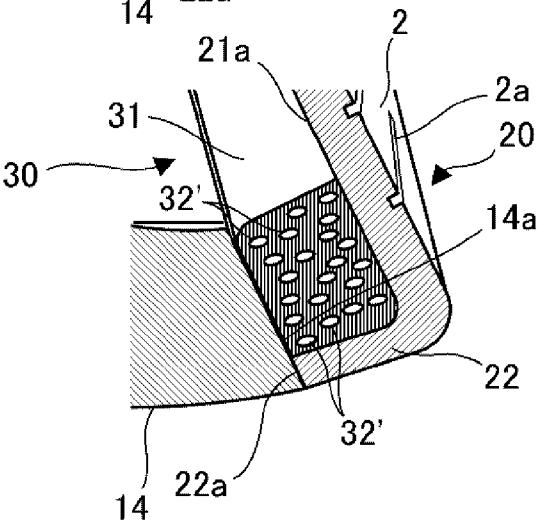


FIG. 4C

FIG. 5

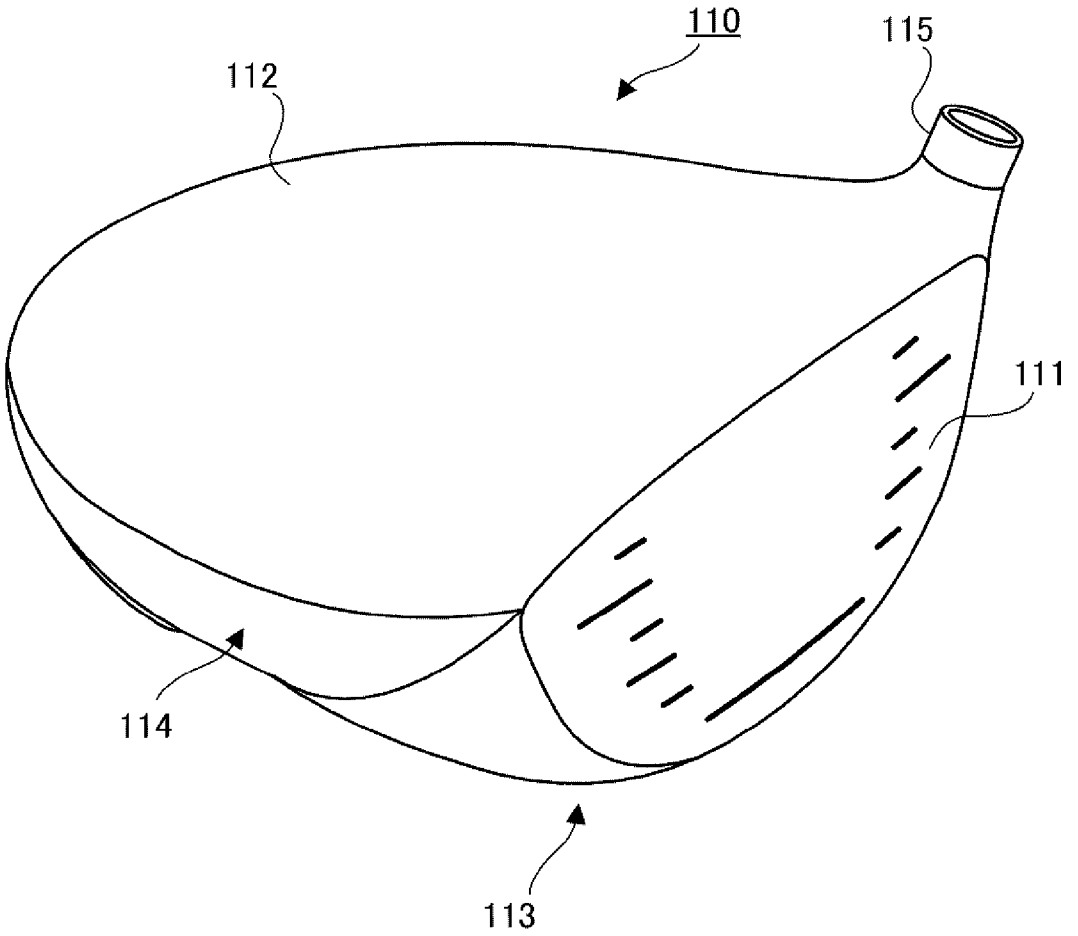


FIG. 6

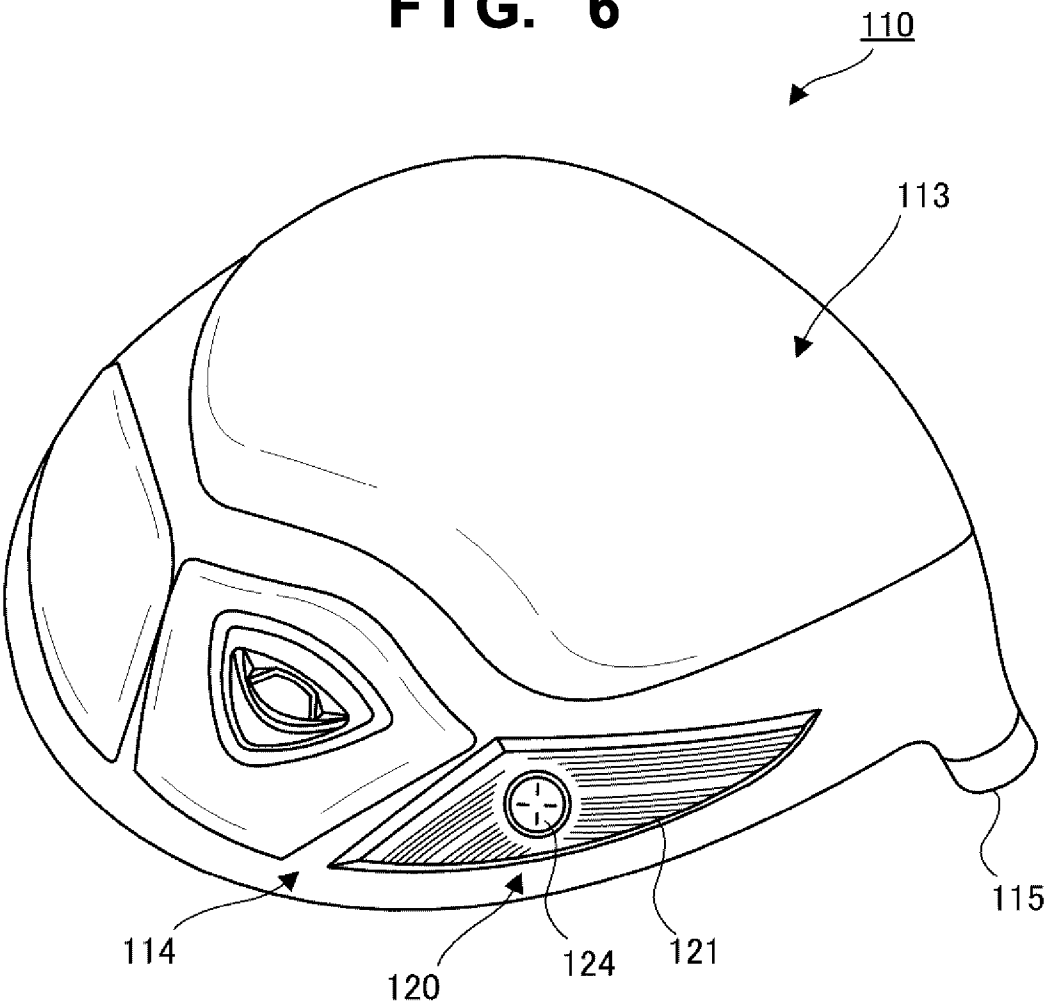
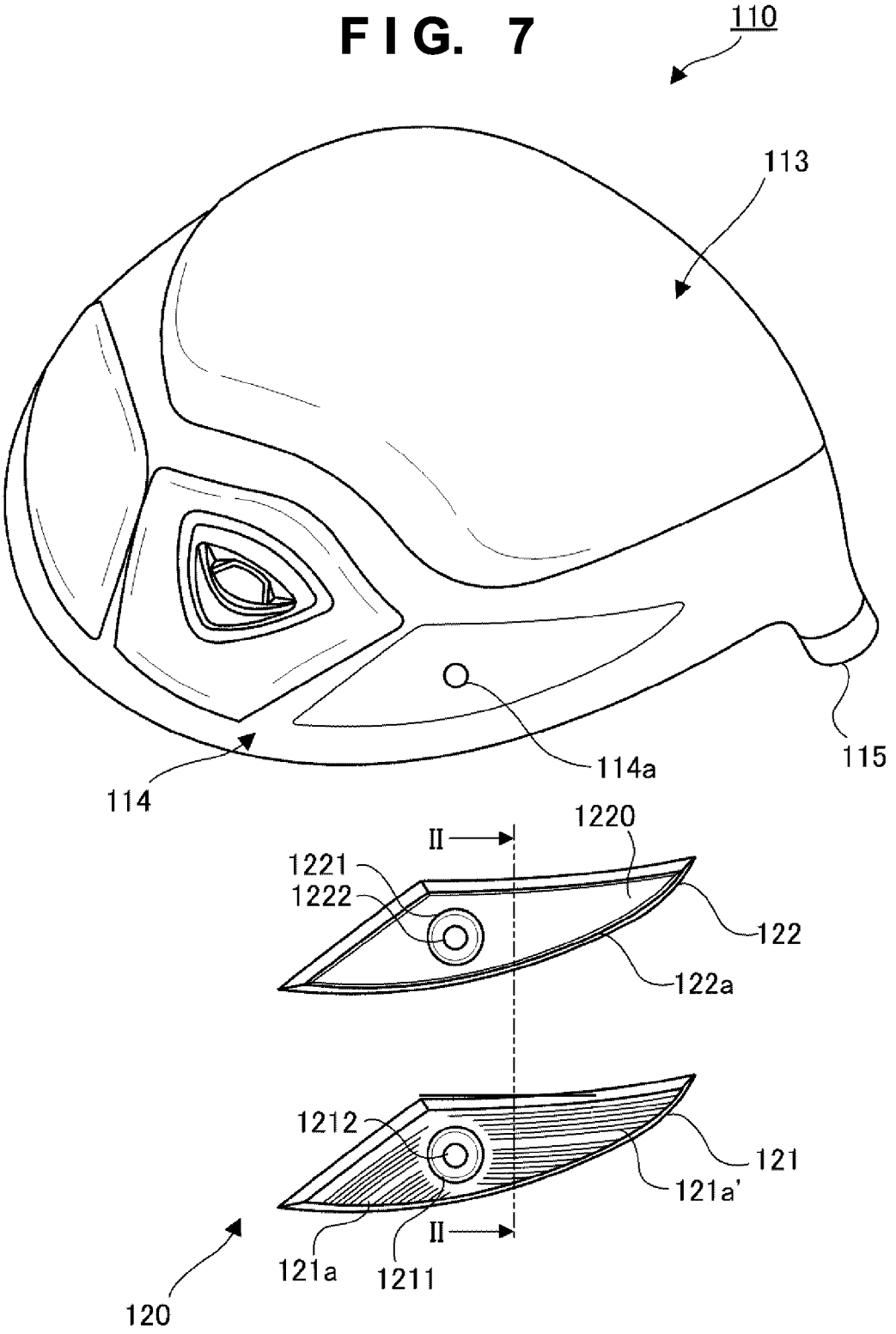


FIG. 7


110
113
114
114a
115
II
1220
1221
1222
122
122a
1212
121
121a'
121a
1211
II
120

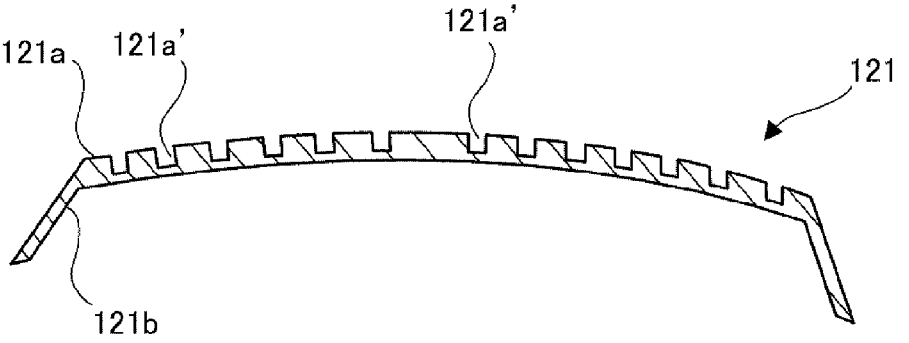


FIG. 8A

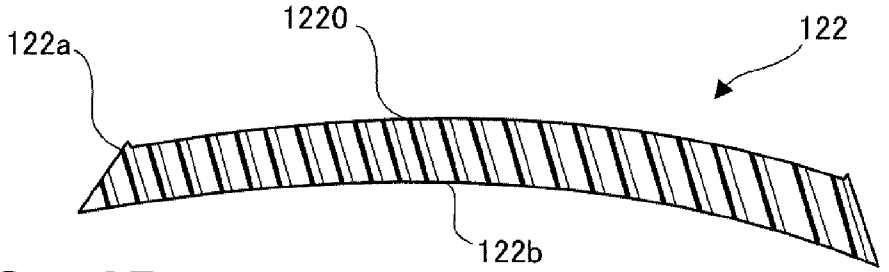


FIG. 8B

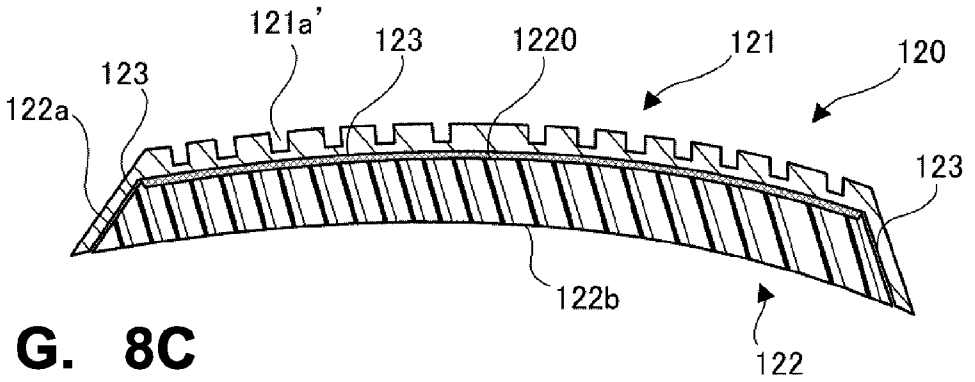


FIG. 8C

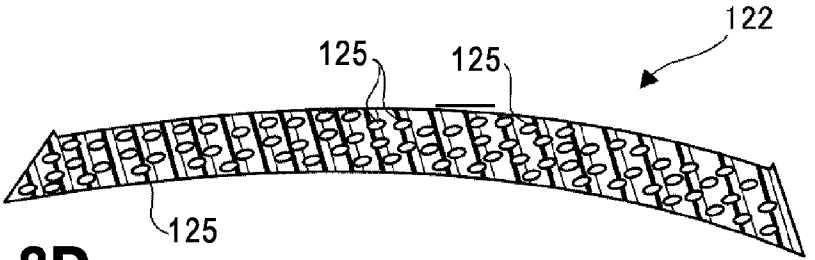


FIG. 8D

GOLF CLUB HEAD

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a golf club head and, more particularly, to a vibration suppression technique at the time of impact.

[0003] 2. Description of the Related Art

[0004] To improve an impact feel and an impact sound, a golf club head equipped with an damping member which suppresses its vibration at the time of impact has been proposed. Japanese Utility Model Laid-Open No. 6-26927, for example, discloses a golf club head provided with a sheet or coating with antivibration performance, and shows synthetic rubber as an example of the material of the sheet.

[0005] When a resin material such as synthetic rubber is used as the damping member, it is often impossible to effectively suppress high-frequency vibration. Also, in the golf club head, the installation space of an damping member is not always large, or the weight of the golf club head increases when a large number of damping members are used. Therefore, the damping member is preferably as small as possible.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to improve the antivibration performance at the time of impact.

[0007] According to an aspect of the present invention, there is provided a golf club head to which an damping member is attached, wherein the damping member is formed by combining a plurality of materials including at least a resin material and a damping alloy.

[0008] According to another aspect of the present invention, there is provided a golf club head to which an damping member is attached, wherein the damping member being formed by combining a plurality of materials including at least a resin material and a magnetic material.

[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** is an external view of a golf club head according to an embodiment of the present invention;

[0011] FIG. **2**A is a sectional view taken alone a line I-I in FIG. **1**;

[0012] FIG. **2**B is a partial enlarged view of the sectional view shown in FIG. **2**A;

[0013] FIG. **3** is an exploded perspective view of the golf club head shown in FIG. **1**;

[0014] FIG. **4**A is an external view of the head body;

[0015] FIGS. **4**B and **4**C are views showing other embodiments of an damping member;

[0016] FIG. **5** is an external view of a golf club head according to another embodiment of the present invention;

[0017] FIG. **6** is an external view of the golf club head, shown in FIG. **5**, when viewed from another direction;

[0018] FIG. **7** is an exploded perspective view of an damping member;

[0019] FIG. **8**A is a sectional end elevational view of a damping alloy taken along a line II-II in FIG. **7**;

[0020] FIG. **8**B is a sectional end elevational view of a resin material taken along the line II-II in FIG. **7**;

[0021] FIG. **8**C is a sectional view of the damping member taken along a cross-section corresponding to the line II-II in FIG. **7**; and

[0022] FIG. **8**D is a view for explaining another example of the resin material.

DESCRIPTION OF THE EMBODIMENTS

First Embodiment

[0023] FIG. **1** is an external view of an iron golf club head **1** according to the first embodiment of the present invention and, more specifically, a perspective view of the golf club head **1** when viewed from the side of a face portion. Although an example in which the present invention is applied to an iron golf club head will be given herein, the present invention is also applicable to wood and utility (hybrid) golf club heads.

[0024] The golf club head **1** includes a face portion (striking surface) **2**, sole portion **3**, and hosel portion **4**. A shaft (not shown) is attached to the hosel portion **4**. A plurality of scorelines **2***a* are formed in the face portion **2**. The scorelines **2***a* are parallel linear grooves extending in the toe-to-heel direction.

[0025] The golf club head **1** includes a head body **10** and a face member **20** fixed to the head body **10**. FIG. **2**A is a sectional view taken along a line I-I in FIG. **1**, FIG. **2**B is a partial enlarged view, FIG. **3** is an exploded perspective view of the golf club head **1**, and FIG. **4**A is an external view of the head body **10** when viewed from the side of the face portion **2**.

[0026] The face member **20** includes a face forming portion **21**, and a front portion forming portion **22** extending from the lower end portion of the face forming portion **21** to the back side. The face forming portion **21** has a front surface which forms the face portion **2**. The front portion forming portion **22** forms a front portion **3***a* of the sole portion **3** (its portion on the side of the face portion **2**).

[0027] The face member **20** is formed by a metal material such as a titanium alloy, stainless steel, maraging steel, or a steel alloy. The face member **20** can be formed by, for example, casting, forging, or press forging in which a plate member is pressed and molded. Forging is advantageous in terms of ease in forming a complex shape.

[0028] The head body **10** includes the hosel portion **4**. The head body **10** also includes an opening portion **10***a* through which the back surface of the face member **20** (a back surface **21***a* of the face forming portion **21**) is exposed to the back side. The opening portion **10***a* is defined by a peripheral edge portion **11**.

[0029] The peripheral edge portion **11** includes an upper portion forming portion **12**, toe-side side forming portion **13**, sole forming portion **14**, and heel-side side forming portion **15**. The side forming portion **13** forms the toe-side side portion of the golf club head **1**, and includes an end surface **13**F on the side of the face portion **2**. The end surface **13**F is divided into an outer region **13**Fa and an inner region **13**Fb on the side of the sole portion **3**. The inner region **13**Fb is recessed more to the back side than the outer region **13**Fa.

[0030] The sole forming portion **14** forms the sole portion **3** other than the front portion **3***a*, and includes an end surface **14***a* on the side of the face portion **2**. A weight member **16** for barycentric position adjustment is fixed to the sole forming portion **14**. The weight member **16** is fixed to the recessed portion formed in the sole forming portion **14**. The weight

member **16** is formed by, for example, a metal material different from that of the head body **10**.

[0031] In the face member **20**, the back surface **21***a* of the face forming portion **21** is fixed to the outer region **13**Fa and the end surface of the upper portion forming portion **12** on the side of the face portion **2**, and an end surface **22***a* of the front portion forming portion **22** on the back side is fixed to the lower portion of the end surface **14***a*. The head body **10** and the face member **20** are fixed to each other by, for example, welding. The inner region **13**Fb and the upper portion of the end surface **14***a* are spaced apart from the back surface **21***a* of the face forming portion **21**.

[0032] The sole forming portion **14** is thicker than the front portion forming portion **22**, as shown in FIG. **2**A. Making the sole forming portion **14** relatively thick improves the rigidity and lowers the center of gravity of the golf club head. Also, making the entire face portion **2** including the front portion forming portion **22** relatively thin allows the face forming portion **21** to easily flex at the time of impact.

[0033] In this embodiment, a gap is formed between the face forming portion **21** and the end surface **14***a* of the sole forming portion **14** by providing the front portion forming portion **22**. With this arrangement, the lower portion of the face forming portion **21** can easily flex. It is therefore possible to suppress a decrease in flight distance when a golf ball is struck by the lower portion of the face portion **2**.

[0034] An damping member **30** is attached in the gap between the face forming portion **21** and the end surface **14***a* of the sole forming portion **14**. The damping member **30** is fixed to this gap by, for example, an adhesive. The damping member **30** is formed by combining a resin material **31** and a damping alloy **32** to constitute a stacked body in this embodiment. The resin material **31** is in contact with the back surface **21***a* of the face forming portion **21**, and the damping alloy **32** is in contact with the end surface **14***a* of the sole forming portion **14**.

[0035] The resin material **31** is made of, for example, a synthetic resin material or a natural resin material (for example, natural rubber). The resin material **31** is preferably made of an elastic body (especially a viscoelastic body), and is, for example, NBR (acrylonitrile butadiene rubber). Examples of the damping alloy **32** are flake graphite cast iron, a magnesium alloy, Silentalloy (Fe—Cr—Al), an Ni—Ti alloy, and an Mn—Cu alloy.

[0036] In this embodiment, the damping alloy **32** is a plate member, which is fixed to the resin material **31** by, for example, an adhesive on its back side. As the damping alloy **32** is stacked on the resin material **31** as a plate member, the rigidity of the damping member **30** can be improved even if a soft resin material is adopted as the resin material **31**. This makes it easy to deal with the damping member **30** in assembling it into the golf club head **1**.

[0037] In this embodiment, as described above, the lower portion of the face forming portion **21** can easily flex, but an impact feel or an impact sound often deteriorates as the amount of flexure increases. However, the damping member **30** facilitates vibration damping. In this way, in this embodiment, an impact feel and an impact sound can be improved while allowing the lower portion of the face portion **2** to easily flex.

[0038] Especially because the damping member **30** is formed by combining the resin material **31** and the damping alloy **32**, the damping alloy **32** can suppress vibration with relatively high frequencies, and the resin material **31** can suppress vibration with relatively low frequencies, thus widening the vibration suppression frequency range. This makes it possible to improve the antivibration performance at the time of impact.

[0039] Also, in this embodiment, the damping member **30** is formed in an L shape, and extends to the gap between the inner region **13**Fb and the back surface **21***a* of the face forming portion **21**. This makes it possible to prevent an impact feel from deteriorating even if a golf ball is struck by a portion on the toe side away from the sweet spot of the face portion **2**.

[0040] Although the damping member **30** is formed by combining two materials: the resin material **31** and the damping alloy **32** in this embodiment, it may be formed by combining three or more materials. For example, the resin material **31** may be mixed with a metal powder for weight adjustment, or fine particles of an inorganic material for improving the vibration energy absorption performance. Examples of the inorganic material are mica, glass, and calcium carbonate.

[0041] Various methods can be adopted to combine the resin material **31** and damping alloy **32**. For example, the arrangement of the resin material **31** and damping alloy **32** may be reversed. This means that the damping alloy **32** may be disposed on the side of the back surface **21***a* of the face forming portion **21**, while the resin material **31** is disposed on the side of the end surface **14***a* of the sole forming portion **14**. Also, a stacked body may be formed by sandwiching the resin material **31** using a pair of plate members **32** made of a damping alloy, as shown in FIG. **4**B. This arrangement makes it easier to deal with the damping member **30** in assembling it into the golf club head **1**. In contrast to an example illustrated in FIG. **4**B, a stacked body may be formed by sandwiching one damping alloy **32** using two resin materials **31**.

[0042] Instead of the method of stacking the resin material **31** and damping alloy **32**, the damping member **30** may be a mixture of the resin material **31** with small pieces **32'** of a damping alloy, as shown in FIG. **4**C. The small pieces **32'** can have various shapes such as a plate, spherical, or rod shape. Also, the damping member **30** may be a mixture of the resin material **31** with fine particles of a damping alloy.

Second Embodiment

[0043] FIGS. **5** and **6** are perspective views of a golf club head **110** according to another embodiment of the present invention, in which FIG. **5** is a perspective view of the golf club head **110** when viewed from above; and FIG. **6** is a perspective view of the golf club head **110** when viewed from below. Although an example in which the present invention is applied to a wood golf club head will be given herein, the present invention is also applicable to iron and utility (hybrid) golf club heads.

[0044] The golf club head **110** takes the form of a hollow body, and its peripheral wall forms a face portion **111**, a crown portion **112**, a sole portion **113**, and a side portion **114**. The face portion **111** forms a face surface (striking surface). The crown portion **112** forms the upper portion of the golf club head **110**. The sole portion **113** forms the bottom portion of the golf club head **110**. The side portion **114** forms the side portion of the golf club head **110**. The side portion **114** includes toe-, back-, and heel-side portions. The golf club head **110** also includes a hosel portion **115** to which a shaft is attached.

[0045] The golf club head **110** can be made of a metal material such as a titanium-based metal (for example, 6Al-4V-Ti titanium alloy), stainless steel, or a copper alloy such as beryllium copper.

[0046] An damping member **120** is fixed to the golf club head **110**, as shown in FIG. **6**. Although the damping member **120** is fixed to the heel-side portion of the side portion **114** in this embodiment, the fixing portion is not limited to this, and may be, for example, the crown portion **112** or sole portion **113**. In this embodiment, the damping member **120** is separably fixed to the golf club head **110** using a bolt **124**. However, the fixing method is not limited to this, and may be adhesion or sticking.

[0047] The damping member **120** not only suppresses vibration of the golf club head **110** at the time of impact, but also functions as an ornament which improves the external appearance of the golf club head **110**.

[0048] FIG. **7** is an exploded perspective view of the damping member **120**. The damping member **120** is formed by adhering a shell-shaped damping alloy **121** and a resin material **122** to each other. FIG. **8**A is a sectional end elevational view of the damping alloy **121** taken along a line II-II in FIG. **7**, FIG. **8**B is a sectional end elevational view of the resin material **122** taken along the line II-II in FIG. **7**, and FIG. **8**C is a sectional view of the damping member **120** taken along a cross-section corresponding to the line II-II in FIG. **7**.

[0049] The damping alloy **121** is formed in a cup shape which opens on the side of mounting on the golf club head **110**. Practical examples of the damping alloy **121** are the same as those of the damping alloy **32**.

[0050] In this embodiment, a plurality of linear grooves **121***a*' are formed in an outer surface **121***a* of the damping alloy **121** to improve the aesthetic design features of the golf club head **110**. An aesthetic design pattern represented not only by such a graphics but also by a text and a color can be formed on the outer surface **121***a* of the damping alloy **121**. Such an aesthetic design pattern may be printed on the outer surface **121***a*.

[0051] A circular recessed portion **1211** is formed at the central portion of the outer surface **121***a* of the damping alloy **121**, and a through hole **1212** into which the bolt **124** is to be inserted is formed at the center of the recessed portion **1211**. The recessed portion **1211** at least partially accommodates the head of the bolt **124**.

[0052] The resin material **122** is a solid material which fills the interior of the damping alloy **121**, and is made of, for example, a resin block having a specific shape formed by molding in advance. Examples of the resin material **122** are the same as those of the resin material **31**.

[0053] The resin material **122** has an adhesive surface **122***a*, and a mounting surface **122***b* to be fitted in the golf club head **110**.

[0054] The adhesive surface **122***a* is a portion adhered to an inner surface **121***b* of the damping alloy **121** by an adhesive layer **123**, and has an outer shape roughly conforming to the shape of the inner surface **121***b*. In this embodiment, since the adhesive layer **123** is formed over the entire region on the adhesive surface **122***a*, the outer shape of the adhesive surface **122***a* is slightly smaller than the shape of the inner surface **121***b* of the damping alloy **121**.

[0055] Further, a slightly recessed, separated portion **1220** is formed in the portion of the adhesive surface **122***a*, which is located behind the surface of the damping alloy **121**, in which the grooves **121***a*' are formed. The separated portion **1220** is more considerably separated from the inner surface **121***b* of the damping alloy **121** than from the remaining portion of the adhesive surface **122***a*. The adhesive layer **123** can be relatively thick in the separated portion **1220**.

[0056] A circular recessed portion **1221** is formed at the central portion of the separated portion **1220**, and a through hole **1222** into which the bolt **124** is to be inserted is formed at the center of the recessed portion **1221**. The recessed portion **1221** partially accommodates the recessed portion **1211** in the damping alloy **121**.

[0057] In this embodiment, the mounting surface **122***b* has an outer shape roughly conforming to that of the golf club head **110**. In this embodiment, since the damping member **120** is fastened to the golf club head **110** using the bolt **124** as a method of fixing the damping member **120** to the golf club head **110**, the mounting surface **122***b* comes into contact (especially, press contact) with the surface of the golf club head **110**. If adhesion or sticking is selected as the fixing method, an adhesive or a sticker is interposed between the mounting surface **122***b* and the surface of the golf club head **110**.

[0058] The adhesive layer **123** adheres the inner surface **121***b* of the damping alloy **121** to the adhesive surface **122***a* of the resin material **122**. The adhesive layer **123** is formed by, for example, supplying a liquid adhesive to the gap between the inner surface **121***b* of the damping alloy **121** and the adhesive surface **122***a* of the resin material **122**, and hardening the adhesive. As the adhesive which forms the adhesive layer **123**, a synthetic adhesive such as an epoxy resin adhesive or an acrylic adhesive is preferable. Especially the use of an adhesive, that has a hardness higher than the resin material **122** after hardening, makes it possible to reinforce the damping alloy **121** and, more specifically, reinforce the surface portion of the damping alloy **121**, in which the grooves **121***a*' are formed, by the adhesive layer **123** formed in the separated portion **1220**.

[0059] After the damping alloy **121** is adhered to the resin material **122**, the bolt **124** is inserted into the holes **1212** and **1222** and screwed into a screw hole **114***a* (FIG. **7**) formed in the golf club head **110**, thereby fixing the damping member **120** to the golf club head **110**.

[0060] In this embodiment, since the damping member **120** is formed by combining the resin material **122** and the damping alloy **121**, the damping alloy **121** can suppress vibration with relatively high frequencies, and the resin material **122** can suppress vibration with relatively low frequencies, thus widening the vibration suppression frequency range. This makes it possible to improve the antivibration performance at the time of impact.

[0061] Also, since the solid resin material **122** fills the interior of the damping alloy **121** and forms the mounting surface **122***b*, the mounting surface **122***b* to be fitted in the golf club head **110** can be formed. This makes it possible not only to stably fix the damping member **120** to the golf club head **110**, but also to transmit vibration of the golf club head **110** to the damping member **120**.

[0062] Since the damping alloy **121** is adhered to the resin material **122** by the adhesive layer **123**, their adhesion strength can be improved. This contributes to tightly fixing the damping alloy **121** and resin material **122** to each other.

[0063] Also, since the resin material **122** forms the mounting surface **122***b*, and the damping member **120** is fixed to the golf club head **110** by fastening using the bolt **124**, the damping member **120** can be more reliably fitted in and fixed to the

golf club head **110** by elastic deformation of the resin material **122**. Moreover, a plurality of types of damping members **120** having different design patterns and weights can be prepared and selected by the user.

[0064] Moreover, the resin material **122** may be mixed with small pieces **125**, as shown in FIG. **8**D. The small pieces **125** can have various shapes such as a plate, spherical, or rod shape. The resin material **122** may be mixed with fine particles of a damping alloy in place of small pieces **125**. In these cases, the damping alloy **121** may be an aluminum alloy or a nickel alloy.

Third Embodiment

[0065] Although an damping member formed by combining a resin material and a damping alloy has been described in the above-mentioned first and second embodiments, a magnetic material may be used in place of a damping alloy. The magnetic material is, for example, ferrite such as barium ferrite or strontium ferrite, or a rare-earth magnet such as a samarium-cobalt magnet or a neodymium-iron-boron magnet, and need only have a magnetic force.

[0066] In this case, the mounting portion of the damping member is a portion, made of a magnetic material (for example, soft iron), of the golf club head. Therefore, the resin material of the damping member is at least partially sandwiched between the golf club head and the magnetic material of the damping member, and a magnetic force acts in its compression direction. This prompts conversion of vibration energy into thermal energy inside the resin material, thus improving the vibration suppression effect provided by the resin material. This makes it possible to obtain a greater vibration suppression effect using a smaller damping member, thus improving the antivibration performance at the time of impact.

[0067] As a practical arrangement example, an arrangement in which the portion made of the damping alloy is replaced with a magnetic material can be adopted in the above-mentioned first and second embodiments. That is, it is possible to adopt an arrangement in which the damping alloy **32** shown in FIGS. **2**A and **2**B or **4**B is replaced with a magnetic material, or an arrangement in which the small pieces **32'** of the damping alloy shown in FIG. **4**C are replaced with a magnetic material. It is also possible to adopt a mixture of a resin material with fine particles of a magnetic material, as a matter of course. It is moreover possible to adopt an arrangement in which the damping alloy **121** shown in FIG. **7** is replaced with a magnetic material.

[0068] It is again possible to adopt an damping member formed by combining three materials: a damping alloy, a magnetic material, and a resin material. In an example shown in FIGS. **2**A and **2**B or **7**, the damping alloy **32** or **121** can be directly adopted to form an arrangement in which small pieces or fine particles of a magnetic material are mixed in the resin material **31** or **122**. This makes it possible not only to widen the vibration suppression frequency range, but also to improve the vibration suppression effect by the resin material.

[0069] 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.

[0070] This application claims the benefit of Japanese Patent Application No. 2012-020300, filed Feb. 1, 2012, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A golf club head to which an damping member is attached, wherein

the damping member is formed by combining a plurality of materials including at least a resin material and a damping alloy.

2. A golf club head to which an damping member is attached, wherein

the damping member being formed by combining a plurality of materials including at least a resin material and a magnetic material.

3. The head according to claim **1**, wherein the damping member is a stacked body of a plate member made of the damping alloy and an elastic body including at least the resin material.

4. The head according to claim **3**, wherein the stacked body includes a pair of the plate members, and the elastic body is sandwiched between the pair of the plate members.

5. The head according to claim **2**, wherein the damping member includes a mixture of the resin material with one of small pieces and fine particles of the magnetic material.

6. The head according to claim **2**, wherein

the damping member is a stacked body of a plate member made of the damping alloy and an elastic body including at least the resin material, and

the elastic body is at least partially disposed between the plate member and a mounting portion of the damping member.

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