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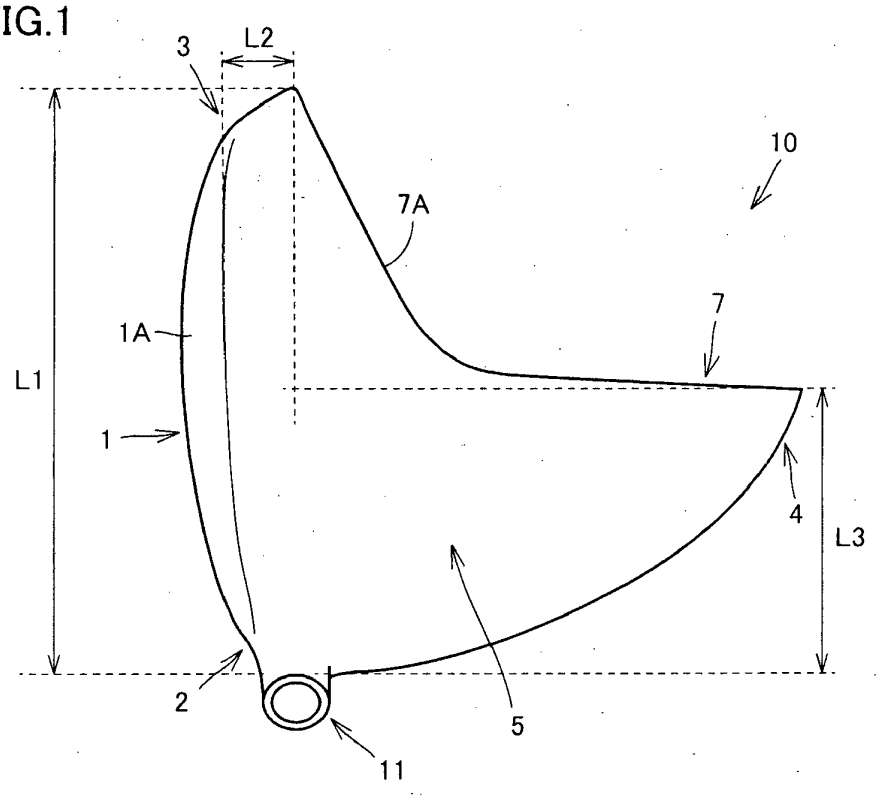
(54) WOOD GOLF CLUB HEAD AND WOOD GOLF CLUB

(57) A wood golf club head (10) used for a driver, comprises: a face portion (1) having a ball hitting surface (1A); a heel portion (2) located at an end on the side of a shaft relative to the ball hitting surface (1A); and a toe portion (3) located at an end facing away from the heel portion (2) relative to the ball hitting surface (1A). A ratio of a maximum length (L1 (unit: mm)) of the wood golf club head (10) in a direction from the heel portion (2) toward the toe portion (3) relative to the volume of the wood golf club head (10) (unit: cm^3) is equal to or greater than 0.30 and equal to or less than 1.04.

FIG.1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a wood golf club head and a wood golf club.

Description of the Background Art

[0002] There is a tendency for wood golf clubs to have a head increased in volume. A head increased in volume generally has a center of gravity having an increased minimal distance to the shaft's axial centerline (or an increased center-of-gravity distance), and accordingly has a tendency for the club face to lag its rotation.

[0003] Accordingly, to avoid club face rotation lag, a wood golf club head having a reduced center-of-gravity distance has been proposed (see Japanese Patent No. 5087328 for example).

SUMMARY OF INVENTION

[0004] However, when conventional wood golf club heads simply have their center-of-gravity distances reduced they have a tendency to also have center-of-gravity depths reduced. As a consequence, such a wood golf club head is difficult to have a sufficiently increased center-of-gravity angle and hence to be improved to sufficiently avoid club face rotation lag.

[0005] The present invention has been made to solve the above problem. A main object of the present invention is to provide a wood golf club head and wood golf club improved to avoid club face rotation lag sufficiently better than a conventional wood golf club head.

[0006] A wood golf club head according to one embodiment of the present invention is a wood golf club head used for a driver, comprising: a face portion having a ball hitting surface; a heel portion located at an end on a side of a shaft relative to the ball hitting surface; and a toe portion located at an end facing away from the heel portion relative to the ball hitting surface. A ratio of a maximum length L1 (unit: mm) of the wood golf club head in a direction from the heel portion toward the toe portion relative to the volume of the wood golf club head (unit: cm^3) is equal to or greater than 0.30 and equal to or less than 1.04.

[0007] A wood golf club head according to one embodiment of the present invention is a wood golf club head used for a fairway wood, comprising: a face portion having a ball hitting surface; a heel portion located at an end on a side of a shaft relative to the ball hitting surface; and a toe portion located at an end facing away from the heel portion relative to the ball hitting surface. A ratio of a maximum length L1 (unit: mm) of the wood golf club head in a direction from the heel portion toward the toe portion relative to the volume of the wood golf club head (unit: cm^3) is equal to or greater than 0.60 and equal to or less than 2.31.

[0008] A wood golf club head according to one embodiment of the present invention is a wood golf club head used for a utility crab, comprising: a face portion having a ball hitting surface; a heel portion located at an end on a side of a shaft relative to the ball hitting surface; and a toe portion located at an end facing away from the heel portion relative to the ball hitting surface. A ratio of a maximum length L1 (unit: mm) of the wood golf club head in a direction from the heel portion toward the toe portion relative to the volume of the wood golf club head (unit: cm^3) is equal to or greater than 0.94 and equal to or less than 3.43.

[0009] The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a plan view for illustrating a wood golf club head according to a first embodiment.

Fig. 2 is a perspective view for illustrating a wood golf club head according to the first embodiment.

Fig. 3 is a front view for illustrating a maximum length L1 of the wood golf club head.

Fig. 4 is a plan view for illustrating another example of the wood golf club head according to the first embodiment.

Fig. 5 is a perspective view for illustrating a wood golf club head according to a second embodiment.

Fig. 6 is a perspective view for illustrating a wood golf club head according to a third embodiment.

Fig. 7 is a perspective view for illustrating a wood golf club head according to a fifth embodiment.

Fig. 8 is a perspective view for illustrating an exemplary variation of the wood golf club head according to the fifth embodiment.

Fig. 9 is a diagram for illustrating the wood golf club head according to the first embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Hereafter, reference will be made to the drawings to describe the present invention in embodiments. In the figures, identical or corresponding components are identically denoted and will not be described repeatedly.

(First Embodiment)

[0012] With reference to Fig. 1, a wood golf club head 10 according to a first embodiment will be described. Wood golf club head 10 is a golf club head used for a wood golf club and is a head used for a driver, a fairway

wood, or a utility club. Hereinafter, a case will be described in which wood golf club head 10 according to the first embodiment is configured as a wood golf club head used for a driver.

[0013] Fig. 1 is a plan view of wood golf club head 10 as a driver head as seen from the side of a crown portion 5. Fig. 2 is a partial perspective view of wood golf club head 10 as the driver head as seen from the side of a sole portion 6.

[0014] As shown in Fig. 1, wood golf club head 10 in the present embodiment includes a face portion 1, a heel portion 2, a toe portion 3, a back portion 4, crown portion 5, and sole portion 6.

[0015] Face portion 1 has a ball hitting surface 1A and is located at a front side of wood golf club head 10. Heel portion 2 is located at an end on the side of a hosel portion 11 (in other words, a shaft 60 (see Fig. 9)) relative to ball hitting surface 1A. Toe portion 3 includes toe portion 3 located at an end facing away from heel portion 2 relative to ball hitting surface 1A. Back portion 4 is located backwardly of face portion 1. Crown portion 5 and sole portion 6 connect face portion 1 and back portion 4, and crown portion 5 is located above face portion 1 and sole portion 6 is located below face portion 1.

[0016] Face portion 1 is formed for example of a material identical to a material which forms a known wood golf club head and can be formed of titanium alloy or the like. Furthermore, heel portion 2, toe portion 3, back portion 4, crown portion 5, and sole portion 6 can be formed of a material identical to a material forming face portion 1.

[0017] A ratio of a maximum length L1 (unit: mm) of wood golf club head 10 in a direction from heel portion 2 toward toe portion 3 relative to the volume of wood golf club head 10 (unit: cm^3) is equal to or greater than 0.30 and equal to or less than 1.04. Note that maximum length L1 of wood golf club head 10 is a maximum value in length of the head, as measured when wood golf club head 10 is placed on a horizontal plane to form set loft and lie angles, as shown in Fig. 3 (hereinafter also referred to as the set condition), and seen in a direction from heel portion 2 toward toe portion 3 parallel to the horizontal plane at a level upper than the horizon plane by 0.857 inch (or 22.23 mm).

[0018] Note that the present inventors have measured wood golf club heads as a plurality of commercially available driver heads regarding the above ratio to find that they all have a ratio equal to or greater than 0.25 and equal to or less than 0.27. The commercially available wood golf club heads had a volume equal to or greater than 449 cm^3 and equal to or less than 466 cm^3, and maximum length L1 equal to or greater than 114.1 mm and equal to or less than 123.1 mm.

[0019] Wood golf club head 10 has a concave area 7 in a region behind ball hitting surface 1A located on the side of toe portion 3. Concave area 7 has a wall portion which isolates the interior of wood golf club head 10 from outside, and that wall portion has an end surface 7A which connects crown portion 5 and sole portion 6. Wood golf club head 10 has a hollow region between face portion 1, and back portion 4 and the wall portion of concave area 7, and between crown portion 5 and sole portion 6.

[0020] Concave area 7 and end surface 7A may have any shape. Concave area 7 is formed such that when wood golf club head 10 in the above set condition is seen in a plan view, for example end surface 7A is perpendicular to the horizontal plane. Concave area 7 is formed such that when wood golf club head 10 in the above set condition is seen in a plan view, for example end surface 7A has an inclination varying relative to a line segment perpendicular to ball hitting surface 1 A. End surface 7A is for example a curved surface.

[0021] Concave area 7 is formed in a region surrounded for example by a line located 10 mm closer to back portion 4 than a boundary of face portion 1 and crown portion 5 in a direction perpendicular to ball hitting surface 1 A and a line located 45 mm closer to toe portion 3 than a most projecting point of heel portion 2 at a level upper by 0.875 inch (or 22.23 mm) than the horizontal plane in a direction parallel to ball hitting surface 1A. From a different viewpoint, when concave area 7 is maximized, end surface 7A of concave area 7 is such that a minimum distance L2 thereto from the boundary of face portion 1 and crown portion 5 is 10 mm and a minimum distance L3 therefrom to heel portion 2 is 45 mm.

[0022] When wood golf club head 10 is compared in volume with a wood golf club head without concave area 7, wood golf club head 10 has a smaller volume as it has concave area 7. Wood golf club head 10 has a volume for example equal to or greater than 25% of that of the wood golf club head without concave area 7 and equal to or less than 86% of that of the wood golf club head without concave area 7. In other words, the wood golf club head without concave area 7 has a volume of equal to or greater than 449 cm^3 and equal to or less than 465 cm^3, whereas wood golf club head 10 has a volume equal to or greater than 117 cm^3 and equal to or less than 401 cm^3.

[0023] Furthermore, the ratio of maximum length L1 of wood golf club head 10 relative to the volume of wood golf club head 10 becomes higher as concave area 7 becomes larger and wood golf club head 10 becomes smaller in volume. Note that wood golf club head 10 shown in Fig. 1 and Fig. 2 is that provided when the volume ratio is 66% and the length-to-volume ratio is 0.40.

[0024] In that case, wood golf club head 10, having concave area 7 formed on the side of toe portion 3, has a center of gravity closer to heel portion 2 (or hosel portion 11) than the conventional wood golf club head without concave area 7 does. Accordingly, wood golf club head 10 has a shorter center-of-gravity distance than the conventional wood golf club head. Centroid distance means a minimum distance from the shaft axis to the center of gravity.

[0025] In addition, wood golf club head 10, having back portion 4, is prevented from having a center of gravity closer to ball hitting surface 1A than the conventional

wood golf club head without concave area 7 even though wood golf club head 10 has concave area 7 behind ball hitting surface 1A. Accordingly, wood golf club head 10 has center-of-gravity depth deeper than the conventional wood golf club head. Centroid depth means a length of a perpendicular extended from the center of gravity of wood golf club head 10 to ball hitting surface 1 A. In other words, center-of-gravity depth refers to a minimum distance between the center of gravity of wood golf club head 10 and a point at which the perpendicular extended from the center of gravity to ball hitting surface 1 A intersects ball hitting surface 1A, i.e., a sweet spot.

[0026] Although wood golf club head 10 has a shorter center-of-gravity distance than the conventional wood golf club head, wood golf club head 10 has a deeper center-of-gravity depth than the conventional wood golf club head. Accordingly, wood golf club head 10 has a larger center-of-gravity angle than the conventional wood golf club head. Center-of-gravity angle is an angle formed by ball hitting surface 1A and the perpendicular when the shaft 60 (see Fig. 9) portion of golf club 100 is placed on a horizontal place such as on a desk or the like. When wood golf club head 10 has ball hitting surface 1 A rounded in a direction from heel portion 2 toward toe portion 3 (i.e., when a bulge is formed), the angle is measured such that the center of ball hitting surface 1 A in the above direction is in contact.

[0027] Wood golf club head 10 may be molded by casting, for example. In that case, wood golf club head 10 can be easily produced by using a die corresponding to a dimension of concave area 7.

[0028] With reference to Fig. 9, wood golf club 100 is configured by attaching shaft 60 and a grip 61 to wood golf club head 10. Wood golf club 100 includes shaft 60, grip 61 attached to one end of shaft 60, and wood golf club head 10 attached to the other end of shaft 60 opposite to grip 61. Shaft 60 has the other end connected to hosel portion 11 of golf club head 10. Shaft 60 and grip 61 can be a well-known shaft and a well-known grip, respectively.

[0029] Hereinafter, a function and effect of wood golf club head 10 according to the first embodiment will be described. Wood golf club head 10 as a driver head is such that a ratio of maximum length L1 (unit: mm) of wood golf club head 10 in a direction from heel portion 2 toward toe portion 3 relative to the volume of wood golf club head 10 (unit: cm^3) is equal to or greater than 0.30 and equal to or less than 1.04.

[0030] This allows wood golf club head 10 to have a smaller volume than a conventional wood golf club head having a length-to-volume ratio equal to or greater than 0.25 and equal to or less than 0.27, and thus be reduced in weight. The weight reduction provides a surplus mass, which can be allocated appropriately to allow wood golf club head 10 to have a shorter center-of-gravity distance and a deeper center-of-gravity depth, and hence a larger center-of-gravity angle than the conventional wood golf club head so that when wood golf club 100 is used to hit a ball the club easily rotates about the shaft's axis. As a result, wood golf club head 10 is sufficiently improved in catching a ball as compared with the conventional wood golf club head.

[0031] If the above length-to-volume ratio is less than 0.30, then, as compared with the conventional wood golf club head, wood golf club head 10 cannot have a center of gravity positionally sufficiently moved and cannot sufficiently be improved in catching a ball. In contrast, if the length-to-volume ratio exceeds 1.04, then, the overall amount of a metallic material configuring wood golf club head 10 decreases, and it would be difficult for wood golf club head 10 to ensure sufficient strength. The length-to-volume ratio falling within the above range allows sufficient improvement in catching a ball and also ensures sufficient strength.

[0032] Furthermore, such wood golf club head 10 can be implemented by having concave area 7 in a region behind ball hitting surface 1A located on the side of toe portion 3. Although wood golf club head 10 is reduced in weight by being provided with concave area 7, wood golf club head 10 has concave area 7 in a region behind ball hitting surface 1A located on the side of toe portion 3 and thus has a center of gravity appropriately positioned, and wood golf club head 10 is thus improved in catching a ball without reallocating the surplus mass provided as a result of the weight reduction. In other words, wood golf club head 10 catches a ball better than the conventional wood golf club head and is also smaller in weight than the conventional wood golf club head.

[0033] Furthermore, at least a portion of the surplus mass provided by forming concave area 7 can be reallocated appropriately to adjust the position of the center of gravity of wood golf club head 10 so that it has a further shorter center-of-gravity distance and a further deeper center-of-gravity depth. For example, wood golf club head 10 having the surplus mass allocated in a region close to heel portion 2 and located on the side of back portion 4 relative to face portion 1 can have a shorter center-of-gravity distance and a deeper center-of-gravity depth than the conventional wood golf club head.

[0034] Furthermore, wood golf club head 10 having a deep center-of-gravity depth allows an increased moment of inertia. Note that the moment of inertia of wood golf club head 10 refers to a moment of inertia when a line passing through the center of gravity of wood golf club head 10 vertically serves as an axis, and a moment of inertia when a line passing through the center of gravity of wood golf club head 10 horizontally serves as an axis. When a ball is hit at a spot other than the sweet spot, the hitting point is offset from the sweet spot, and wood golf club head 10 rotates about the center of gravity, however, wood golf club head 10 allowing an increased moment of inertia can reduce its rotation. As a result, it can achieve high stability in the direction of the hit ball, driving distance, and the like.

[0035] Fig. 4 shows wood golf club head 10 according to the first embodiment with the above volume ratio being

25% and the above length-to-volume ratio being 1.04. Thus, by forming concave area 7 to be larger than in wood golf club head 10 shown in Fig. 1 and Fig. 2, the above length-to-volume ratio can be increased within the above range, and the center-of-gravity distance can be reduced while the center-of-gravity depth can be increased. As a result, the center-of-gravity angle can further be increased, and catching a ball can further be improved.

[0036] Note that, with reference to Fig. 1, concave area 7 may be such that a portion which indicates minimum distance L2 between end surface 7A and ball hitting surface 1A and a portion which indicates minimum distance L3 between end surface 7A and heel portion 2 are an end of concave area 7 located on the side of toe portion 3 and an end of concave area 7 located on the side of back portion 4, respectively. Furthermore, with reference to Fig. 4, concave area 7 may be such that a portion which indicates minimum distance L2 between end surface 7A and ball hitting surface 1A and a portion which indicates minimum distance L3 between end surface 7A and heel portion 2 are a portion located closer to heel portion 2 than the end of concave area 7 located on the side of toe portion 3 and a portion located closer to face portion 1 than the end of concave area 7 located on the side of back portion 4, respectively.

(Second Embodiment)

[0037] With reference to Fig. 5, a wood golf club head 20 according to a second embodiment will be described. Wood golf club head 20 according to the second embodiment basically has a configuration similar to that of wood golf club head 10 according to the first embodiment, except that concave area 7 does not have a wall portion which isolates the interior of wood golf club head 20 from outside. In other words, wood golf club head 20 differs from wood golf club head 10 in that concave area 7 is not provided with end surface 7A that connects crown portion 5 and sole portion 6.

[0038] Concave area 7 has an opening which connects the interior of wood golf club head 20 (the hollow region) to outside. End surface 7A of concave area 7 is formed to surround the opening.

[0039] This still allows wood golf club head 20 according to the second embodiment to have concave area 7 and also provides concave area 7 without a wall portion, and wood golf club head 20 can thus have a larger center-of-gravity angle than a conventional wood golf club head and achieve an effect similar to that of wood golf club head 10 according to the first embodiment. Furthermore, wood golf club head 20 having concave area 7 without a wall portion can also have a smaller weight than golf club head 10 and also have a smaller center-of-gravity distance than golf club head 10. This allows for example a more surplus mass to be reallocated to allow wood golf club head 20 to be sufficiently improved in catching a ball.

(Third Embodiment)

[0040] With reference to Fig. 6, a wood golf club head 30 according to a third embodiment will be described. Wood golf club head 30 according to the third embodiment basically has a configuration similar to that of wood golf club head 10 according to the first embodiment, except that wood golf club head 30 includes a fixed member 8 fixed to at least a portion of concave area 7.

[0041] Fixed member 8 is formed of a material having a lower specific gravity than a body material forming face portion 1, heel portion 2, toe portion 3, back portion 4, crown portion 5, and sole portion 6. When wood golf club head 30 is formed of the same material except for fixed member 8, fixed member 8 is formed of a material having a lower specific gravity than a material forming wood golf club head 30 such as face portion 1 other than fixed member 8. Fixed member 8 is preferably formed of a material of large strength. Fixed member 8 is mainly formed of at least one material selected from a group consisting for example of aluminum (Al), magnesium (Mg), FRP (fiber reinforced plastics), and engineering plastics. Fixed member 8 may have a center of gravity at any position.

[0042] Although fixed member 8 may have any structure, for example it has a hollowed shell structure. Fixed member 8 has a plurality of surfaces formed to be contiguous to the external surfaces of toe portion 3, back portion 4, crown portion 5, and sole portion 6, respectively. In other words, fixed member 8 has a surface configuring an external surface of wood golf club head 30, formed such that the surface is contiguous to the external surfaces of toe portion 3, back portion 4, crown portion 5, and sole portion 6 of wood golf club head 30.

[0043] When this is described from a different viewpoint, wood golf club head 30 including fixed member 8 is provided to have an overall volume equal to a volume that a wood golf club head has when it does not have concave area 7. In that case, fixed member 8 has a volume equal to or greater than 14% of the overall volume of wood golf club head 30 and equal to or less than 75% of the overall volume of wood golf club head 30.

[0044] Although fixed member 8 may be fixed to concave area 7 in any method unless fixed member 8 comes off or the like when wood golf club head 30 hits a ball, preferably, fixed member 8 is fixed to concave area 7 for example by adhesion, brazing, screwing, press-fitting or other similar mechanical coupling.

[0045] This also allows the wood golf club head to achieve a reduced mass in a region behind ball hitting surface 1A located on the side of toe portion 3, as compared with a conventional wood golf club head which does not have concave area 7, since fixed member 8 is formed of a material having a lower specific gravity than a material forming face portion 1. As a result, wood golf club head 30 can achieve an effect similar to that of wood golf club head 10 according to the first embodiment. More specifically, wood golf club head 30 has a shorter center-of-gravity distance and a deeper center-of-gravity depth,

and hence a larger center-of-gravity angle, and thus catches a ball sufficiently better than the conventional wood golf club head.

[0046] Fixed member 8 may have a center of gravity on the side of heel 2 as seen in the direction from heel portion 2 toward toe portion 3 in a state in which fixed member 8 is fixed to concave area 7.

[0047] When wood golf club head 30 including such a fixed member 8 is compared with wood golf club head 30 including fixed member 8 having a center of gravity on the side of toe portion 3 as seen in the direction from heel portion 2 toward toe portion 3, the former has a center of gravity closer to heel portion 2 in the above direction than the latter and can thus reduce the center-of-gravity distance while increasing the center-of-gravity depth, and hence increase the center-of-gravity angle. In other words, wood golf club head 30 including such a fixed member 8 is also improved in catching a ball, in particular, in wood golf club head 30 according to the third embodiment.

[0048] Furthermore, wood golf club head 30 that includes fixed member 8 can reduce a sense of incongruity at the time of addressing, as compared with wood golf club head 10 according to the first embodiment which does not have fixed member 8.

[0049] Note that fixed member 8 may have a solid structure. Furthermore, fixed member 8 may have an end surface in contact with end surface 7A of the wall portion of concave area 7.

(Fourth Embodiment)

[0050] A wood golf club head according to a fourth embodiment will now be described. The wood golf club head according to the fourth embodiment basically has a configuration similar to that of wood golf club head 30 according to the third embodiment, except that concave area 7 does not have a wall portion which isolates the interior of the wood golf club head from outside.

[0051] More specifically, the wood golf club head according to the fourth embodiment corresponds to wood golf club head 20 according to the second embodiment as shown in Fig. 5 with concave area 7 having fixed member 8 fixed thereto according to the third embodiment shown in Fig. 6.

[0052] As a result, the wood golf club head according to the fourth embodiment can achieve an effect similar to that of wood golf club head 30 according to the third embodiment.

[0053] In that case, fixed member 8 may be fixed to concave area 7 in any method, and fixed member 8 is fixed to concave area 7 for example by adhesion, brazing, screwing, press-fitting or other similar mechanical coupling.

[0054] Furthermore, as concave area 7 does not have the wall portion, weight reduction can be achieved by the mass of the wall portion. The wood golf club head may have the mass of the wall portion reallocated or eliminated. This also allows the wood golf club head according to the fourth embodiment to achieve an effect similar to that of wood golf club head 30 according to the third embodiment.

(Fifth Embodiment)

[0055] With reference to Fig. 7, a wood golf club head 50 according to a fifth embodiment will be described. The wood golf club head according to the fifth embodiment basically has a configuration similar to that of wood golf club head 10 according to the first embodiment, except that the former has a high specific gravity portion 40 formed of a material of a higher specific gravity than a material forming face portion 1.

[0056] High specific gravity portion 40 is provided at a position which can increase the center-of-gravity angle of wood golf club head 50, as compared with wood golf club head 10. More specifically, high specific gravity portion 40 is provided at any of: a position allowing a center-of-gravity distance shorter than that of wood golf club head 10 while maintaining a center-of-gravity depth equivalent to that of wood golf club head 10; a position allowing a center-of-gravity depth deeper than that of wood golf club head 10 while maintaining a center-of-gravity distance equivalent to that of wood golf club head 10; or a position allowing both a center-of-gravity distance shorter than that of wood golf club head 10 and a center-of-gravity depth deeper than that of wood golf club head 10.

[0057] High specific gravity portion 40 is provided for example on sole portion 6 in a region 41 located on the side of back portion 4 relative to face portion 1 and located on the side of heel portion 2 relative to concave area 7. In other words, high specific gravity portion 40 is provided in a region free of concave area 7 on sole portion 6 of region 41 for example located between heel portion 2 and back portion 4.

[0058] High specific gravity portion 40 may be formed of any material having a higher specific gravity than a material forming face portion 1, and it is formed for example of tungsten (W) or a tungsten alloy.

[0059] High specific gravity portion 40 preferably has an overall mass equal to or smaller than a mass reduced, as compared with a conventional wood golf club head free of concave area 7, by being provided with concave area 7.

[0060] High specific gravity portion 40 may be fixed to wood golf club head 50 in any method, and it is fixed to wood golf club head 50 for example by adhesion, brazing, screwing, press-fitting or other similar mechanical coupling. Furthermore, in wood golf club head 50 when high specific gravity member 40 is formed of a material identical to that of a body other than face portion 1 (i.e., back portion 4, crown portion 5, sole portion 6, etc.), then, in casting the body, a weight adding portion corresponding to high specific gravity member 40 may integrally be formed by casting.

[0061] Thus wood golf club head 50 has a deeper center-of-gravity depth than that of wood golf club head 10 while having a center-of-gravity distance equivalent to or shorter than that of wood golf club head 10 by virtue of high specific gravity portion 40. Accordingly, wood golf club head 50 has a larger center-of-gravity angle than wood golf club head 10 and thus catches a ball further better.

[0062] Furthermore, wood golf club head 50, having concave area 7, is sufficiently lighter in weight than the conventional wood golf club head free of concave area 7. Accordingly, wood golf club head 50 can also have a smaller overall mass than the conventional wood golf club head even though wood golf club head 50 has high specific gravity portion 40.

[0063] Fig. 8 is a perspective view of a wood golf club head 51 as an exemplary variation of wood golf club head 50 according to the fifth embodiment, as seen from the side of sole portion 6. Wood golf club head 51 basically has a configuration similar to that of wood golf club head 30 according to the third embodiment, except that the former has high specific gravity portion 40 formed of a material of a higher specific gravity than a material forming face portion 1. Thus, the wood golf club head according to the fifth embodiment may be configured to basically have a configuration similar to any of wood golf club heads 10, 20, 30 according to the first to fourth embodiments with high specific gravity portion 40 fixed thereto. In that case, high specific gravity portion 40 may be fixed to wood golf club heads 10, 20, 30 according to the first to fourth embodiments by adhesion, brazing, screwing, press-fitting or other similar mechanical coupling, as has been set forth above, or may be cast and thus integrally formed, and thus fixed thereto.

[0064] While wood golf club heads 10, 20, 30, 50 according to the first to fifth embodiments are all provided as a wood golf club head used for a driver, they are not limited thereto. Wood golf club heads 10, 20, 30, 50 according to the first to fifth embodiments may be configured as a wood golf club head used for a fairway wood or may be configured as a wood golf club head used for a utility club.

[0065] When wood golf club heads 10, 20, 30, 50 according to the first to fifth embodiments are a golf club head for a fairway wood, they basically have a configuration similar to that which the heads have when they are configured as a golf club head for a driver, except that a ratio of maximum length L1 (unit: mm) of wood golf club heads 10 in a direction from heel portion 2 toward toe portion 3 relative to the volume of wood golf club heads 10, 20, 30, 50 (unit: cm^3) is equal to or greater than 0.60 and equal to or less than 2.31.

[0066] When wood golf club heads 10, 20, 30, 50 according to the first to fifth embodiments are a utility club head, they basically have a configuration similar to that which the heads have when they are configured as a golf club head for a driver, except that a ratio of maximum length L1 (unit: mm) of wood golf club heads 10 in a direction from heel portion 2 toward toe portion 3 relative to the volume of wood golf club heads 10, 20, 30, 50 (unit: cm^3) is equal to or greater than 0.94 and equal to or less than 3.43.

[0067] Note that the present inventors have measured a plurality of commercially available fairway wood heads regarding the above ratio to find that they all have a ratio equal to or greater than 0.52 and equal to or less than 0.58. More specifically, these commercially available fairway wood heads have a volume equal to or greater than 117 cm^3 and equal to or less than 192 cm^3 and maximum length L 1 equal to or greater than 99.6 mm and equal to or less than 102.2 mm. Furthermore, the present inventors have measured a plurality of commercially available utility club heads regarding the above ratio to find that they all have a ratio equal to or greater than 0.81 and equal to or less than 0.86. More specifically, these commercially available utility club heads have a volume equal to or greater than 114 cm^3 and equal to or less than 121 cm^3 and maximum length L 1 equal to or greater than 94.4 mm and equal to or less than 99.4 mm.

[0068] Wood golf club heads 10, 20, 30, 50 as such a fairway wood head or a utility club head have a volume for example equal to or greater than 25% and equal to or less than 86% of that which the wood golf club head as the fairway wood head has when it does not have concave area 7.

[0069] Accordingly, wood golf club heads 10, 20, 30, 50 as a fairway wood head or a utility club head can achieve an effect similar to that of wood golf club heads 10, 20, 30, 50 as a driver head as described above.

[0070] If wood golf club heads 10, 20, 30, and 50 as a fairway wood head have the above length-to-volume ratio below 0.60, they cannot have a center of gravity positionally sufficiently moved and cannot sufficiently be improved in catching a ball, as compared with a conventional wood golf club head. In contrast, if wood golf club heads 10, 20, 30, and 50 as a fairway wood head have the length-to-volume ratio above 2.31, then, the overall amount of a metallic material configuring the wood golf club head decreases, and it would be difficult for the wood golf club head to ensure sufficient strength. In other words, by having the length-to-volume ratio set to be equal to or greater than 0.60 and equal to or less than 2.31, wood golf club heads 10, 20, 30, 50 as a fairway wood head can be sufficiently improved in catching a ball and also ensure sufficient strength.

[0071] If wood golf club heads 10, 20, 30, and 50 as a utility club head have the above length-to-volume ratio below 0.94, they cannot have a center of gravity positionally sufficiently moved and cannot sufficiently be improved in catching a ball, as compared with a conventional wood golf club head. In contrast, if wood golf club heads 10, 20, 30, and 50 as a utility club head have the above length-to-volume ratio above 3.43, then, the overall amount of a metallic material configuring the wood golf club head decreases, and it would be difficult for the wood golf club head to ensure sufficient strength. In other

words, by having the length-to-volume ratio set to be equal to or greater than 0.94 and equal to or less than 3.43, wood golf club heads 10, 20, 30, 50 as a utility club head can be sufficiently improved in catching a ball and also ensure sufficient strength.

[0072] Wood golf club heads 10, 20, 30, 50 as a fairway wood head or a utility club head can be smaller in volume and lighter in weight than a wood golf club head as a conventional fairway wood head or utility club head. Being lighter in weight allows a surplus mass, which can be allocated appropriately to allow wood golf club heads 10, 20, 30, 50 to have a shorter center-of-gravity distance and a deeper center-of-gravity depth, and hence a larger center-of-gravity angle than the conventional wood golf club head.

[0073] Furthermore, wood golf club heads 10, 20, 30, 50 as a fairway wood head or a utility club head can be implemented by having concave area 7 formed in a region behind ball hitting surface 1A located on the side of toe portion 3. Although such a wood golf club head 10 is reduced in weight by being provided with concave area 7, wood golf club head 10 has concave area 7 in a region behind ball hitting surface 1A located on the side of toe portion 3 and thus has a center of gravity appropriately positioned without reallocating the surplus mass resulting from the weight reduction, and it is thus improved in catching a ball.

[0074] It should be understood that the embodiments disclosed herein have been described for the purpose of illustration only and in a non-restrictive manner in any respect. The scope of the present invention is defined by the terms of the claims, rather than the description above, and is intended to include any modifications within the meaning and scope equivalent to the terms of the claims.

INDUSTRIAL APPLICABILITY

[0075] While the present invention has been described in embodiments, it should be understood that the embodiments disclosed herein are illustrative and non-restrictive in any respect. The scope of the present invention is defined by the terms of the claims, and is intended to include any modifications within the meaning and scope equivalent to the terms of the claims.

Claims

1. A wood golf club head (10) used for a driver, comprising:

a face portion (1) having a ball hitting surface (1A);
a heel portion (2) located at an end on a side of a shaft relative to the ball hitting surface (1A); and
a toe portion (3) located at an end facing away from the heel portion (2) relative to the ball hitting surface (1A).
a ratio of a maximum length L1 (unit: mm) of the wood golf club head in a direction from the heel portion (2) toward the toe portion (3) relative to a volume of the wood golf club head (unit: cm^3) being equal to or greater than 0.30 and equal to or less than 1.04.

2. A wood golf club head used for a fairway wood comprising:

a face portion (1) having a ball hitting surface (1A);
a heel portion (2) located at an end on a side of a shaft relative to the ball hitting surface (1A); and
a toe portion (3) located at an end facing away from the heel portion (2) relative to the ball hitting surface (1A),
a ratio of a maximum length L1 (unit: mm) of the wood golf club head in a direction from the heel portion (2) toward the toe portion (3) relative to a volume of the wood golf club head (unit: cm^3) being equal to or greater than 0.60 and equal to or less than 2.31.

3. A wood golf club head used for a utility crab, comprising:

a face portion (1) having a ball hitting surface (1A);
a heel portion (2) located at an end on a side of a shaft relative to the ball hitting surface (1A); and
a toe portion (3) located at an end facing away from the heel portion (2) relative to the ball hitting surface (1A),
a ratio of a maximum length L1 (unit: mm) of the wood golf club head in a direction from the heel portion (2) toward the toe portion (3) relative to a volume of the wood golf club head (unit: cm^3) being equal to or greater than 0.94 and equal to or less than 3.43.

4. The wood golf club head according to any one of claims 1-3, wherein a concave area is formed in a region behind the ball hitting surface (1A) located on a side of the toe portion (3).

5. The wood golf club head according to claim 4, comprising a fixed member fixed to at least a portion of the concave area, wherein the fixed member is formed of a material having a lower specific gravity than a material forming the face portion (1).

6. The wood golf club head according to claim 5, wherein the fixed member has a volume equal to or greater than 14% of an overall volume of the wood golf club

head and equal to or less than 75% of the overall volume of the wood golf club head.

7. The wood golf club head according to any one of claims 4-6, wherein the concave area has a wall portion isolating an interior of the wood golf club head from outside.

8. A wood golf club comprising the wood golf club head according to any one of claims 1-7.

FIG.1

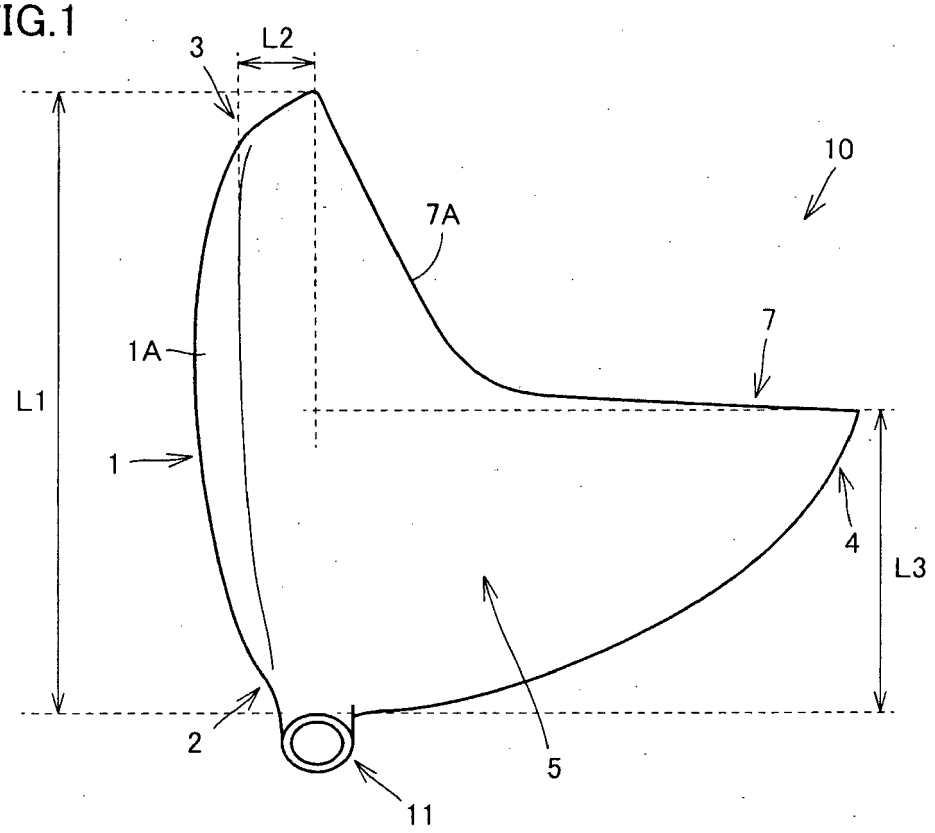


FIG.2

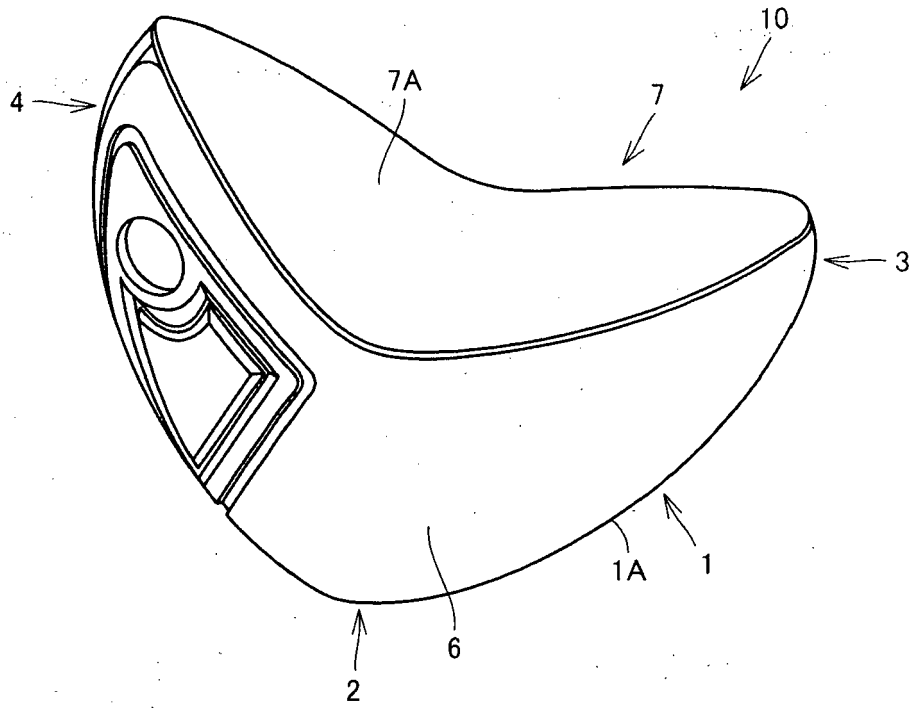


FIG.3

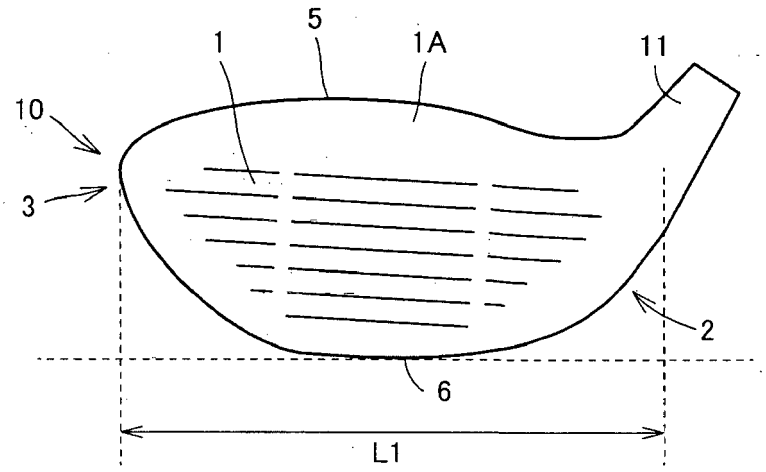


FIG.4

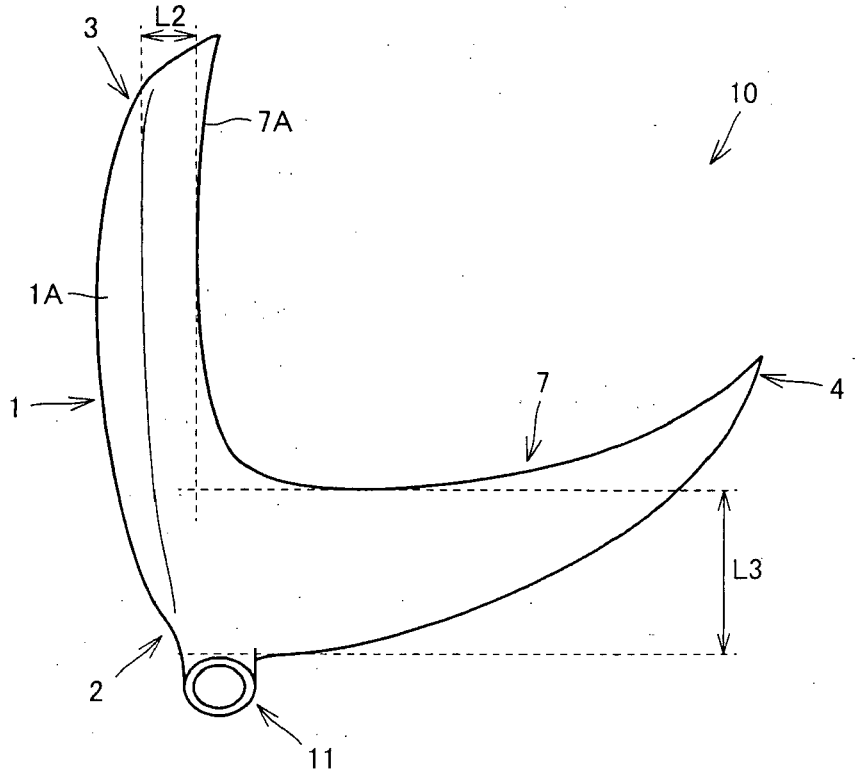


FIG.5

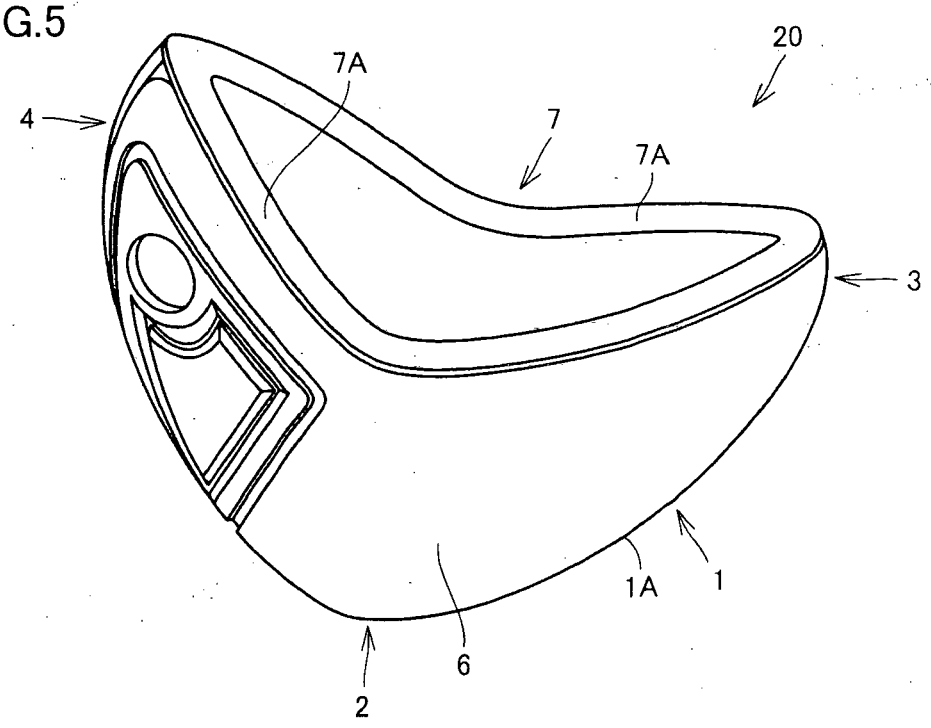


FIG.6

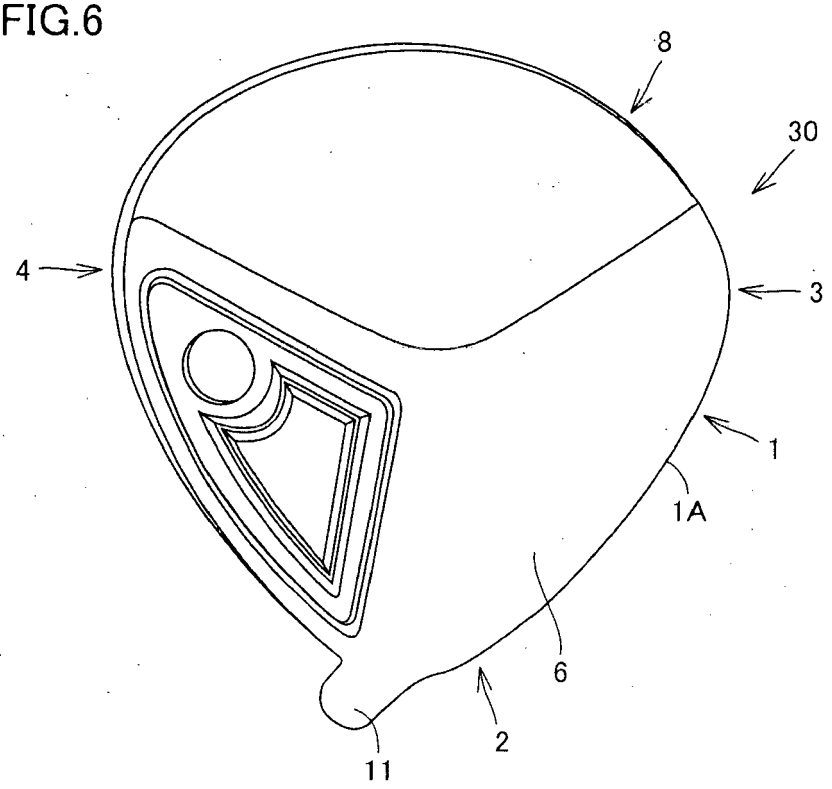


FIG.7

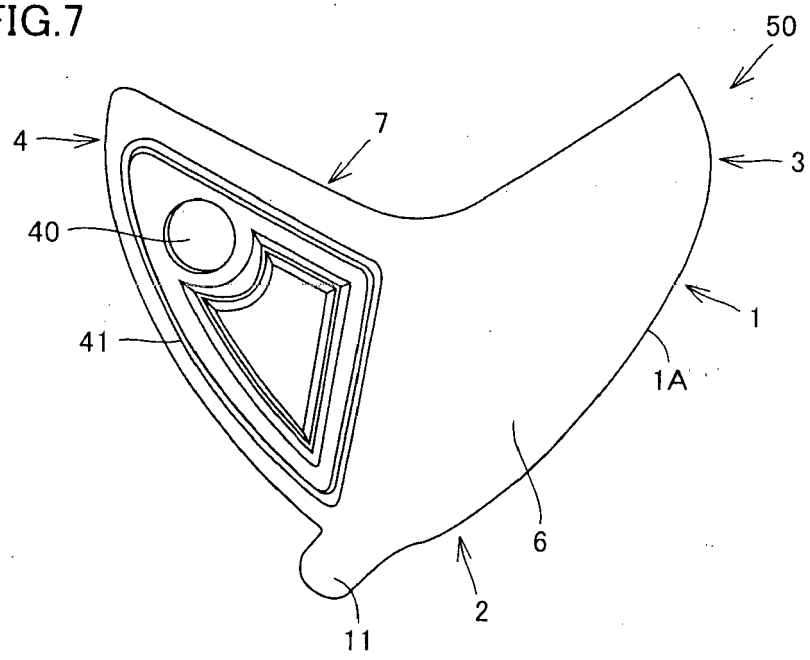


FIG.8

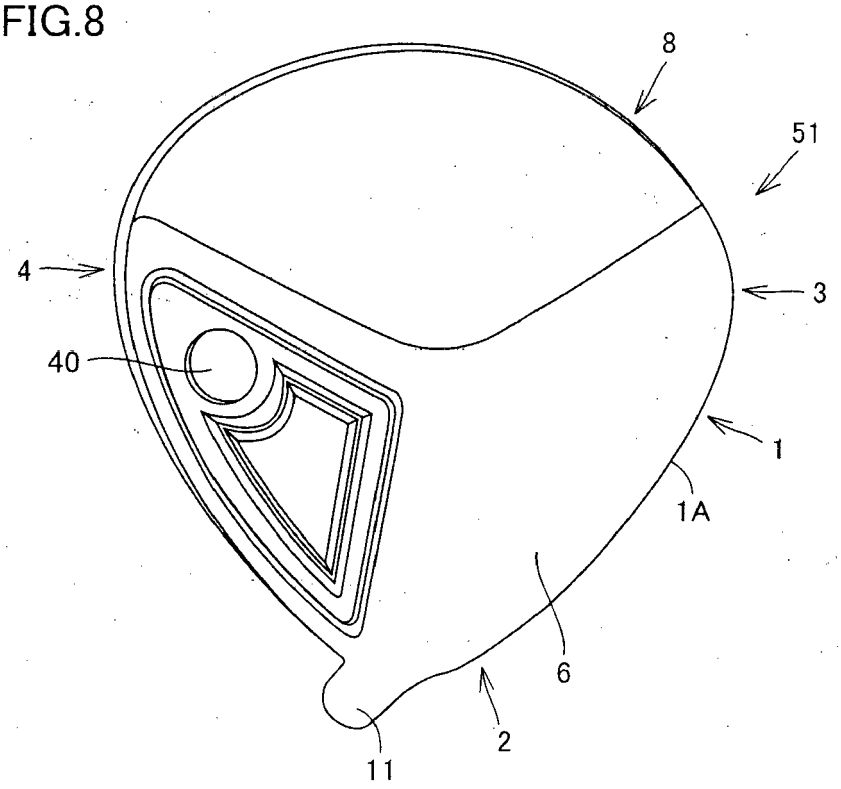
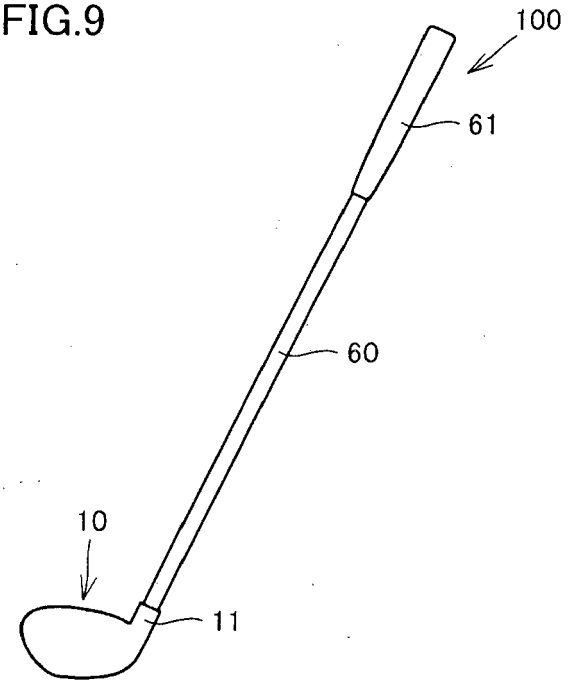


FIG.9



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EUROPEAN SEARCH REPORT

Application Number
EP 16 16 1110

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 354 961 B1 (ALLEN DILLIS V [US]) 12 March 2002 (2002-03-12) * column 12, line 48 - column 13, line 59; figures 1-3 *	1-3,8	INV. A63B53/04
X	US 1 916 792 A (JAMES HADDEN WILLIAM) 4 July 1933 (1933-07-04) * figures 1-4 *	1-8	
X	US 5 497 995 A (SWISSHELM CHARLES T [US]) 12 March 1996 (1996-03-12) * figures 5-6 *	1-8	
X	US 2013/324306 A1 (STITES JOHN T [US] ET AL) 5 December 2013 (2013-12-05) * figures *	1-3,8	
X	US 2013/184099 A1 (STITES JOHN T [US] ET AL) 18 July 2013 (2013-07-18) * figures 4A,4B,5A,5B *	1-3,8	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 July 2016	Lundblad, Hampus

CATEGORY OF CITED DOCUMENTS

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13-07-2016

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