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(54) **GOLF CLUB SHAFT AND GOLF CLUB**

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(57) **ABSTRACT**

A golf club shaft includes an outer shaft and an inner shaft disposed in a hollow portion of the outer shaft. A void portion is formed between the outer shaft and the inner shaft. The golf club shaft has a double structure including the outer shaft and the inner shaft. This allows both of the shafts to integrally operate and also allows one of the shafts to primarily operate.

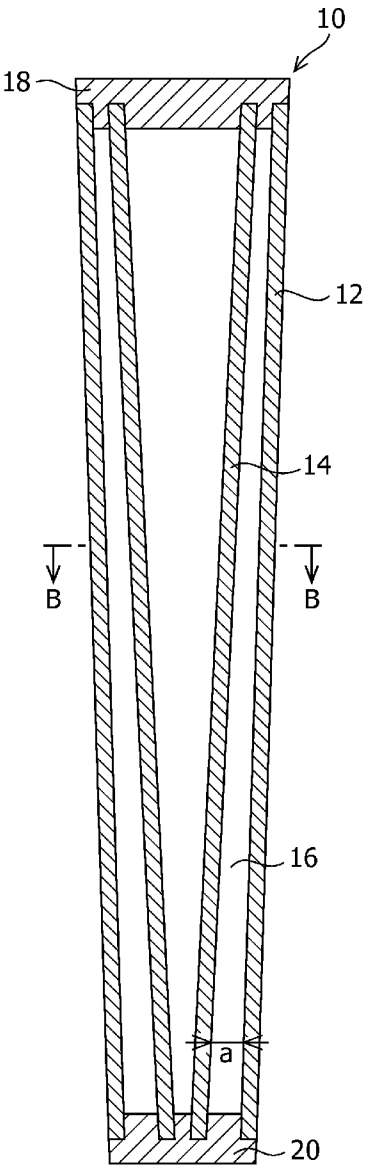


FIG.1

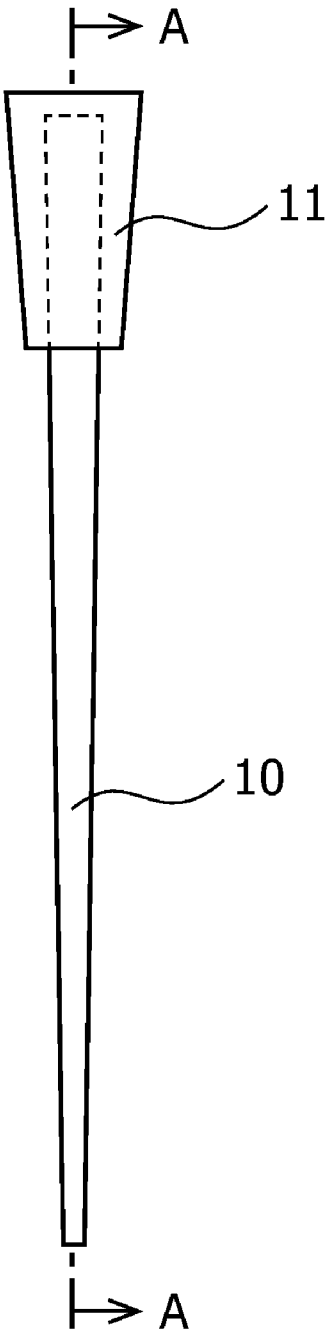


FIG.2(a)

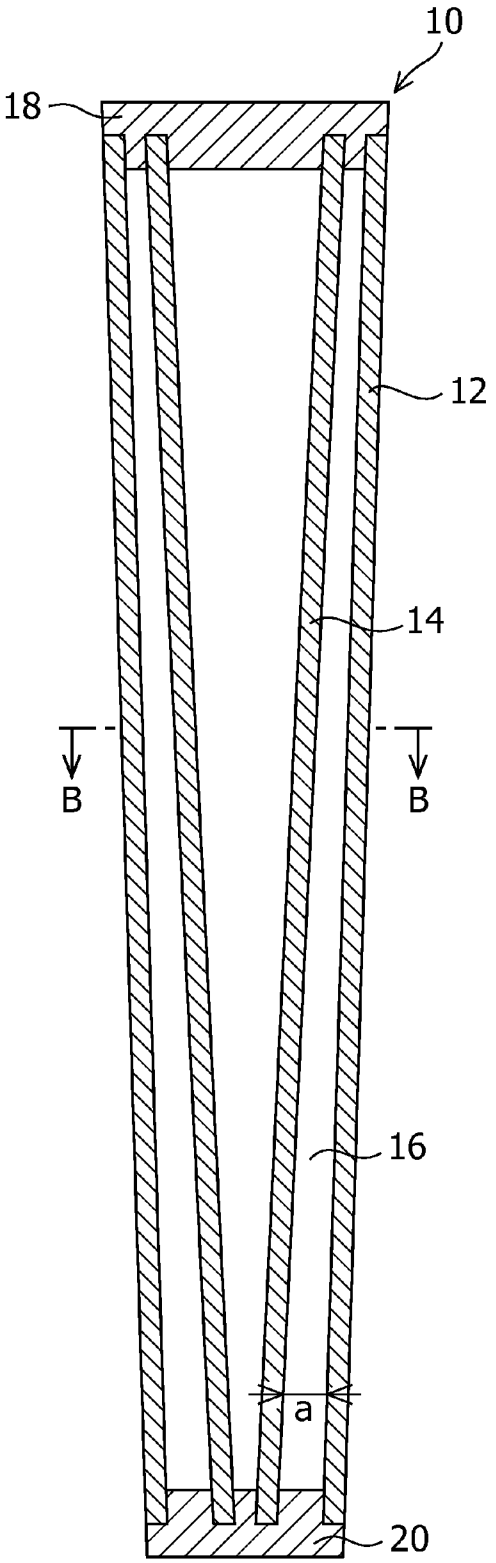


FIG.2(b)

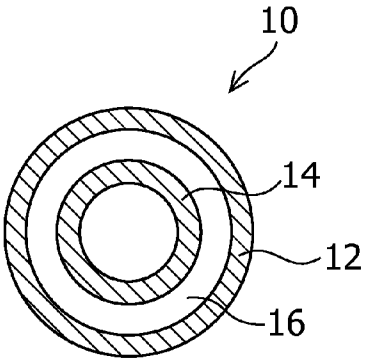


FIG.3(a)

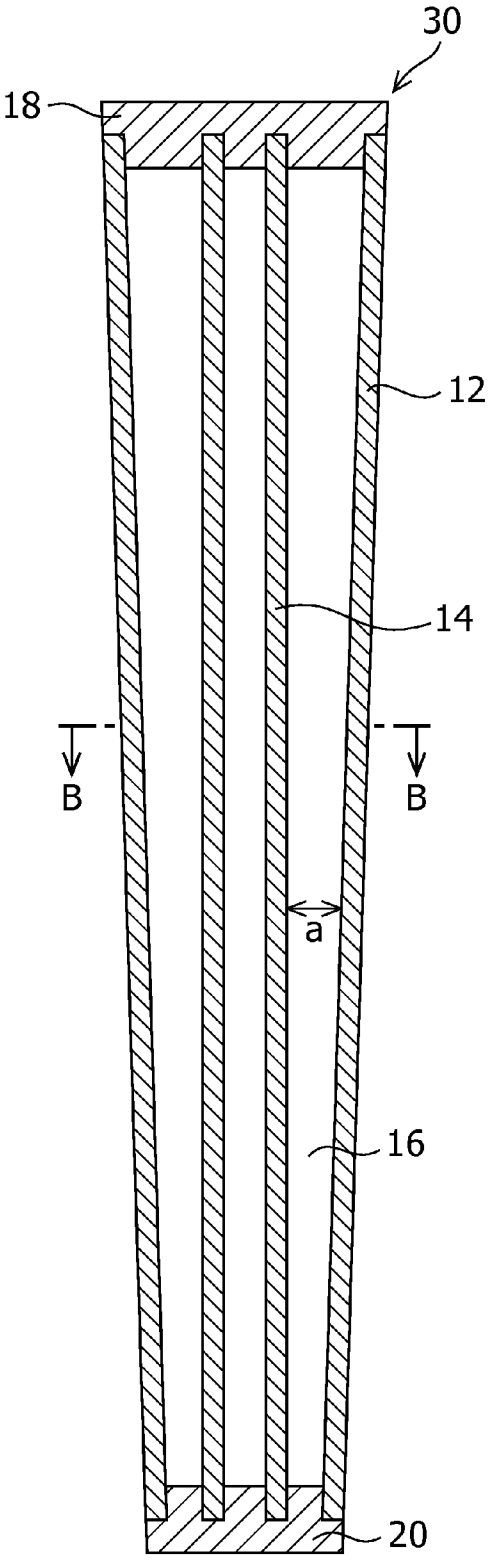


FIG.3(b)

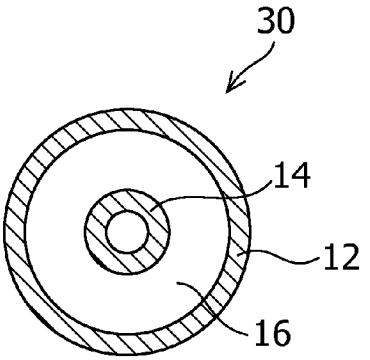


FIG.4(a)

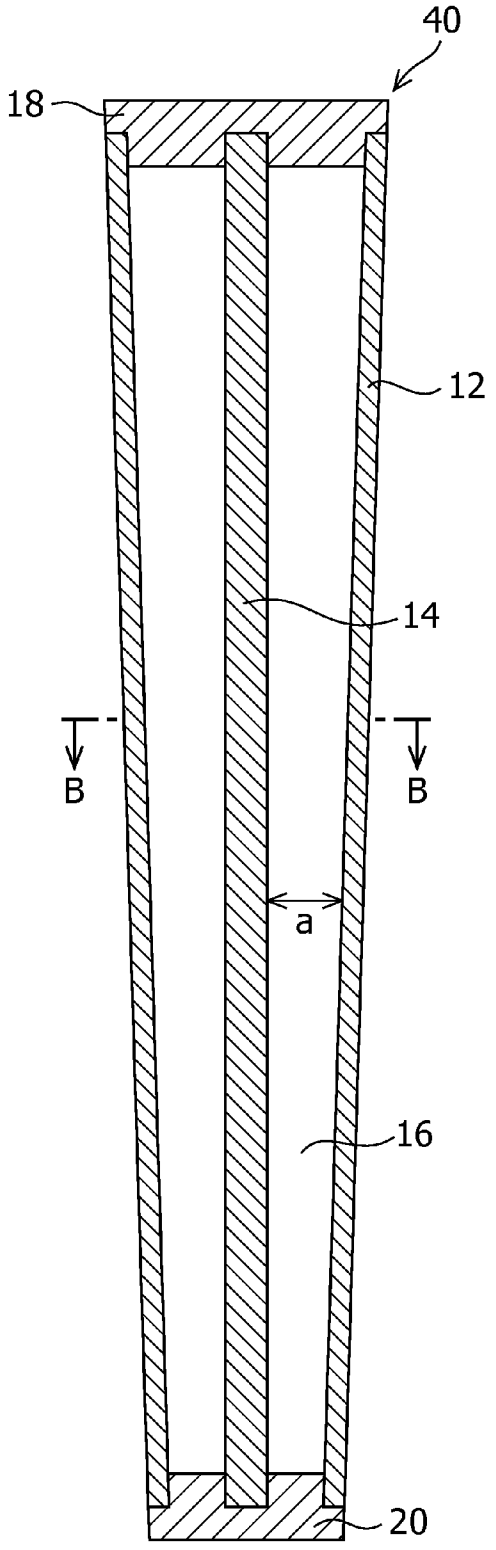


FIG.4(b)

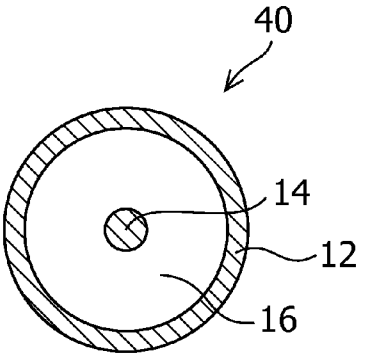


FIG.5(a)

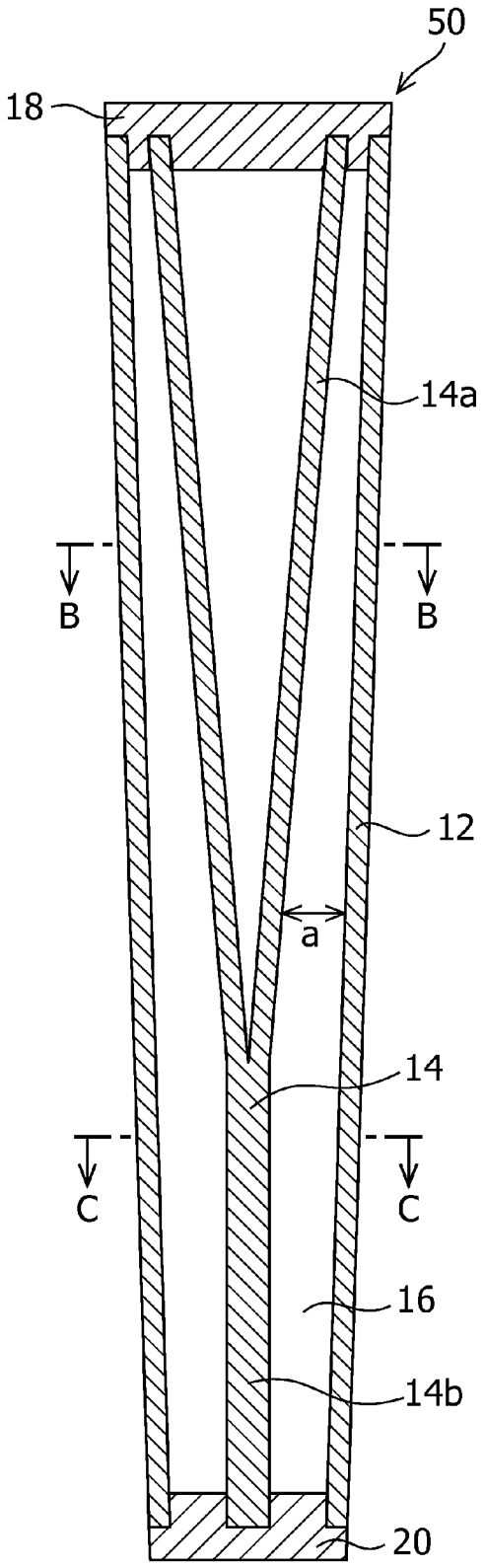


FIG.5(b)

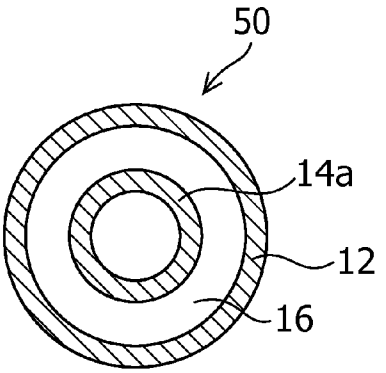


FIG.5(c)

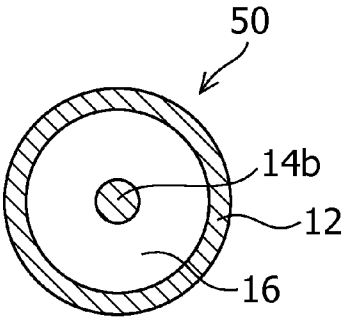


FIG.6

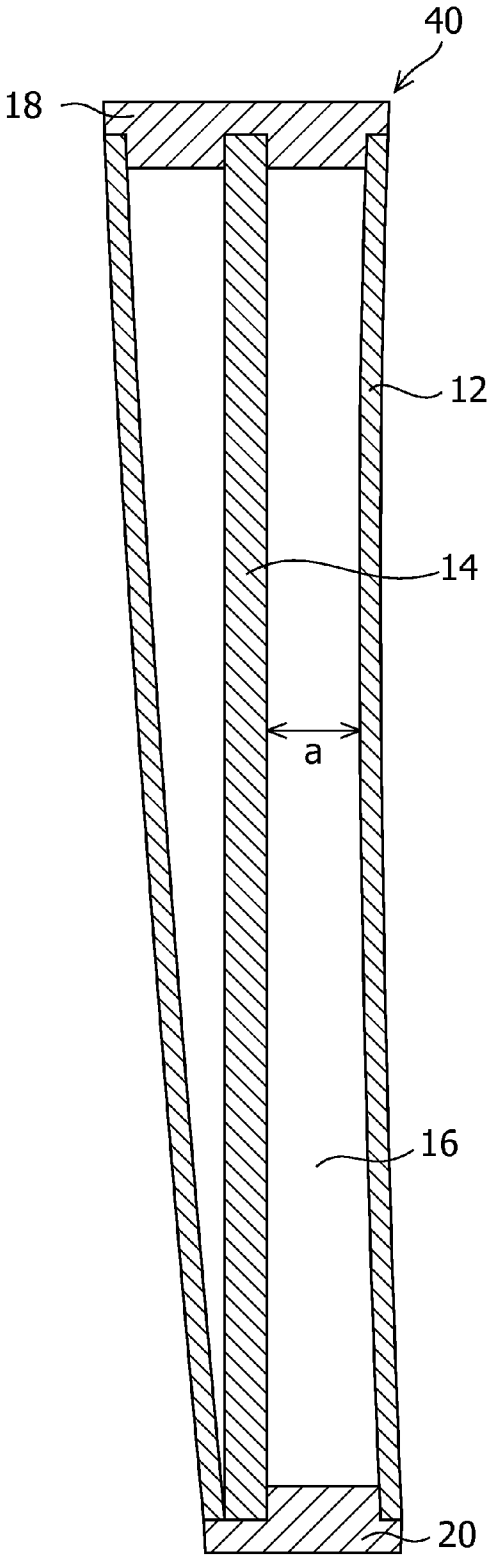
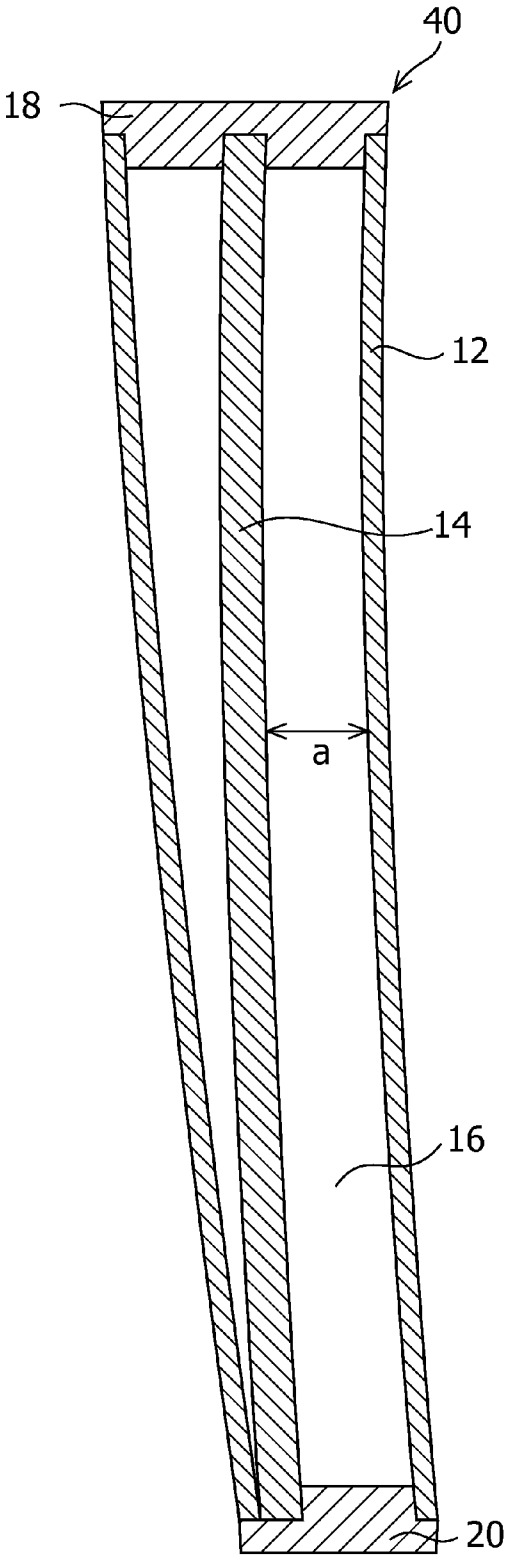


FIG.7



GOLF CLUB SHAFT AND GOLF CLUB

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority on Japanese Patent Application No. 2010-004567 filed Jan. 13, 2010, which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to a golf club shaft having a double structure including an outer shaft and an inner shaft, and to a golf club using the golf club shaft.

[0003] Japanese Patent No. 3647034 has previously proposed a golf club shaft having a double structure including an outer shaft and an inner shaft. A golf club shaft according to claim **1** in the publication includes an outer shaft and an inner shaft inserted in the outer shaft. The outer shaft and the inner shaft each have such a tapered shape that the diameter is smaller at the distal end and larger at the proximal end. The inner shaft is inserted at a position at which the inner diameter of the outer shaft matches the outer diameter of the distal end of the inner shaft. The inner shaft is substantially integrated with the outer shaft in such a state that the distal end of the inner shaft is located at a position displaced from the distal end of the outer shaft toward the proximal end of the outer shaft while the proximal end of the inner shaft reaches at least the proximal end position of the outer shaft.

[0004] A golf club shaft according to claim **3** in the above publication includes an outer shaft and an inner shaft inserted in the outer shaft. The outer shaft and the inner shaft each have a tapered shape such that the diameter is smaller at the distal end and larger at the proximal end. The inner shaft is inserted in the outer shaft. The inner shaft is substantially integrated with the outer shaft in a state such that the distal end of the outer shaft is located at a position displaced from the distal end of the inner shaft toward the proximal end of the inner shaft while the proximal end of the inner shaft is located at the same position as the proximal end of the outer shaft.

[0005] The golf club shafts in the publication described above have high bending stiffness and torsional stiffness at a portion at which the outer shaft overlaps the inner shaft. This overlapping portion helps the hitting of a ball in a desired direction. Meanwhile, part of the distal end portion of one of the outer shaft and the inner shaft does not overlap the other. The stiffness at this non-overlapping part is low, and there is likely to be flexing. Thus, by utilizing the repulsive force of this flexing, the head speed at impact is increased, and even a less-powerful player can increase the driving distance (section [0007] in the above publication).

[0006] However, in the golf club shaft in that publication, the outer shaft and the inner shaft are integrated with each other. This allows both of the shafts to integrally operate but does not allow one of the shafts to primarily operate. Thus, the golf club shaft may still be improved in this regard.

SUMMARY OF THE INVENTION

[0007] The present invention has been made under the above circumstances. The present invention is a golf club shaft which has a double structure including an outer shaft and an inner shaft, and which allows both of the shafts to integrally operate and also allows one of the shafts to primarily operate. An object of the present invention is to provide a golf club shaft that exhibits excellent performance by these operations of such shafts and to provide a golf club using the golf club shaft.

[0008] In order to achieve the above object, the present invention provides a golf club shaft including: an outer shaft having a hollow portion; and an inner shaft disposed in the hollow portion of the outer shaft. In the golf club shaft, a void portion is formed between the outer shaft and the inner shaft. Furthermore, the present invention provides a golf club including the golf club shaft according to the present invention described above.

[0009] In the golf club shaft of the present invention, the outer shaft and the inner shaft are separate bodies from each other. In addition, the outer shaft and the inner shaft are apart from each other. Thereby, the outer shaft and the inner shaft can operate independently. Thus, when a golfer slow in head speed swings the golf club of the present invention, the outer shaft flexes, but the inner shaft does not flex at all or flexes little depending on the head speed. Accordingly, the shaft as a whole is flexible and suitable for a golfer slow in head speed. The flexibility of the shaft is utilized to increase the head speed or to increase the launch angle of a ball; thereby, the driving distance can be increased. In contrast, when a golfer fast in head speed swings the golf club of the present invention, both of the shafts flex together greatly. Accordingly, the shaft as a whole is stiff and suitable for a golfer fast in head speed. The stiffness of the shaft is utilized to increase the initial speed of a ball; thereby, the driving distance can be increased.

[0010] In the golf club shaft of the present invention, the appropriate lower limit and upper limit of the width of the aforementioned void portion are approximately 0.1 mm and approximately 7 mm, respectively. This is because the above-described operations and effects of the present invention can be reliably obtained with such a width. The lower limit and the upper limit of the preferable range of the width of the void portion are approximately 0.5 mm and approximately 6 mm, respectively. Nevertheless, a proximal end of the inner shaft may be in contact with an inner surface of the outer shaft.

[0011] When a golfer slow in head speed swings the golf club with the golf club shaft of the present invention, the shaft is flexible while primarily the outer shaft flexes. This allows increase in a launch angle of a ball and thus allows increase in the driving distance. Meanwhile, when a golfer fast in head speed swings the golf club with the golf club shaft of the present invention, the shaft is stiff while the outer shaft and the inner shaft flex together. This allows increase in the initial speed of a ball and thus allows increase in the driving distance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** is a schematic front view illustrating an embodiment of a golf club shaft according to the present invention.

[0013] FIG. **2**A is a schematic cross-sectional view taken along the line A-A in FIG. **1**, illustrating a first embodiment of the golf club shaft according to the present invention.

[0014] FIG. **2**B is a schematic cross-sectional view taken along the line B-B in FIG. **2**A.

[0015] FIG. **3**A is a schematic cross-sectional view taken along the line A-A in FIG. **1**, illustrating a second embodiment of the golf club shaft according to the present invention.

[0016] FIG. **3**B is a schematic cross-sectional view taken along the line B-B in FIG. **3**A.

[0017] FIG. **4**A is a schematic cross-sectional view taken along the line A-A in FIG. **1**, illustrating a third embodiment of the golf club shaft according to the present invention.

[0018] FIG. **4**B is a schematic cross-sectional view taken along the line B-B in FIG. **4**A.

[0019] FIG. **5**A is a schematic cross-sectional view taken along the line A-A in FIG. **1**, illustrating a fourth embodiment of the golf club shaft according to the present invention.

[0020] FIG. **5**B is a schematic cross-sectional view taken along the line B-B in FIG. **5**A.

[0021] FIG. **5**C is a schematic cross-sectional view taken along the line C-C in FIG. **5**A.

[0022] FIG. **6** is an explanatory view showing how the shaft of the third embodiment flexes when a golfer slow in head speed swings a golf club with the shaft.

[0023] FIG. **7** is an explanatory view showing how the shaft of the third embodiment flexes when a golfer fast in head speed swings the golf club with the shaft.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Hereinafter, embodiments of the present invention will be described with reference to the drawings. It should be noted, however, that the present invention is not limited to the following examples.

First Embodiment

[0025] FIGS. **1**, **2**A and **2**B illustrate a first embodiment of a golf club shaft according to the present invention. In FIGS. **2**A and **2**B, a grip **11** is not illustrated. A shaft **10** of the first embodiment includes an outer shaft **12** and an inner shaft **14** disposed in a hollow portion of the outer shaft **12**. A void portion **16** is formed between the outer shaft **12** and the inner shaft **14**. In the first embodiment, each of the outer shaft **12** and the inner shaft **14** has a hollow tapered conical shape such that the diameter is gradually reduced toward the tip end. The outer shaft **12** and the inner shaft **14** have almost equal lengths. The outer shaft **12** preferably has a length with a lower limit of approximately 787 mm and an upper limit of approximately 1219 mm. The outer shaft **12** preferably includes a distal end having an outer diameter with a lower limit of approximately 8.4 mm and an upper limit of approximately 10 mm; a proximal end having an outer diameter with a lower limit of approximately 14 mm and an upper limit of approximately 17 mm; and a wall portion having a thickness with a lower limit of approximately 0.6 mm and an upper limit of approximately 2.5 mm. The inner shaft **14** preferably has a length with a lower limit of approximately 787 mm and an upper limit of approximately 1219 mm. The inner shaft **14** preferably includes a distal end having an outer diameter with a lower limit of approximately 1 mm and an upper limit of approximately 4 mm; a proximal end having an outer diameter with a lower limit of approximately 4 mm and an upper limit of approximately 15.8 mm; and a wall portion having a thickness with a lower limit of approximately 0.6 mm and an upper limit of approximately 4 mm.

[0026] The void portion **16** has a width a, at the distal end, with a lower limit of preferably approximately 1 mm, particularly preferably approximately 2 mm, and an upper limit of preferably approximately 6 mm, particularly preferably approximately 4 mm. Moreover, the width a of the void portion **16** is gradually increased from the proximal end of the golf club shaft toward the distal end thereof. Thus, the width a is larger at the distal end of the golf club shaft than the proximal end thereof. This produces such an operation and effect that flexure at the distal end of the golf club shaft can be utilized to a great extent (in a long range).

[0027] A proximal end portion of the outer shaft **12** is connected to a proximal end portion of the inner shaft **14** through a connecting member **18**. This prevents the inner shaft **14** from coming off from the outer shaft **12**. Examples of the material of the connecting member **18** include rubbers, resins, elastomers, corks, woods, and the like. Moreover, a vibration absorbing member **20** is disposed in the void portion **16** at a position between a distal end portion of the outer shaft **12** and a distal end portion of the inner shaft **14**. This prevents the outer shaft **12** and the inner shaft **14** from making a vibration sound (reverberating noise) during a swing. Examples of the material of the vibration absorbing member **20** include: elastic materials such as rubbers and elastomers; foamed products thereof such as soft sponges made of polyurethane foam; and similar materials.

[0028] As the material of the outer shaft **12** and the inner shaft **14**, a fiber-reinforced resin or a metal can be used. In this case, examples of reinforced fibers in the fiber-reinforced resin include carbon fibers, glass fibers, metal fibers, aramid fibers, silicon carbide fibers, alumina fibers, boron fibers, and the like. Examples of a thermosetting resin in the fiber-reinforced resin include epoxy resins, phenol resins, unsaturated polyester resins, and the like. As a subsidiary material of the fiber-reinforced resin, a curing agent, a curing accelerator, a filler, a release agent, a pigment, and the like can be used. Furthermore, examples of the metal include iron alloys, titanium alloys, and the like. Note that the inner shaft **14** can be formed only of the resin.

[0029] As the outer shaft **12** and the inner shaft **14**, it is possible to use shafts having multiple fiber-reinforced resin layers in which reinforced fibers are arranged in one direction. The fiber-reinforced resin layer can be formed by, for example, a sheet winding method in which a prepreg sheet is wound around a mandrel and is subjected to heating for curing. As the prepreg sheet, it is possible to use reinforced fibers such as a cloth, mat, or a roving aligned in parallel which are impregnated with the thermosetting resin.

[0030] In the shaft **10** of the first embodiment, the outer shaft **12** plays a major role, while the inner shaft **14** plays a minor role. Thus, for the outer shaft **12**, the fiber-reinforced resin layers are preferably mainly biased layers in which fibers are arranged obliquely to the axis of the shaft. Meanwhile, for the inner shaft **14**, the fiber-reinforced resin layers are preferably mainly longitudinal layers in which fibers are arranged in the same direction as the axis of the shaft.

[0031] Note that, when a shaft is formed using a mandrel described above, a releasing agent is applied to the surface of the mandrel. Accordingly, the release agent is attached to an inner surface of the shaft. It is preferable to remove the release agent by polishing the inner surface of the shaft.

Second Embodiment

[0032] FIGS. **3**A and **3**B illustrate a second embodiment of a golf club shaft according to the present invention. In FIGS. **3**A and **3**B, a grip **11** is not illustrated. A shaft **30** of the second embodiment includes an outer shaft **12** and an inner shaft **14** disposed in a hollow portion of the outer shaft **12**. A void portion **16** is formed between the outer shaft **12** and the inner shaft **14**. In the second embodiment, the outer shaft **12** has such a hollow tapered conical shape that the diameter is

gradually reduced toward the tip end. The inner shaft **14** has such a hollow cylindrical shape that the diameter at the proximal end is the same as the diameter at the distal end. The outer shaft **12** and the inner shaft **14** have almost equal lengths. The outer shaft **12** and the inner shaft **14** may each have a length, outer diameter, and thickness of the wall portions which are the same as those in the first embodiment.

[0033] The void portion **16** has a width a, at the distal end, with a lower limit of preferably approximately 1 mm, particularly preferably approximately 2 mm, and an upper limit of preferably approximately 6 mm, particularly preferably approximately 4 mm. Moreover, the width a of the void portion **16** is gradually reduced from the proximal end of the golf club shaft toward the distal end thereof. Thus, the width a is smaller at the distal end of the golf club shaft than the proximal end thereof. This produces such an operation or effect that the inner shaft can be reduced in weight.

[0034] In the second embodiment, the functions and materials of a connecting member **18** and a vibration absorbing member **20**, the materials and forming methods of the outer shaft **12** and the inner shaft **14**, and the like are the same as those in the first embodiment. Accordingly, the descriptions will be omitted.

Third Embodiment

[0035] FIGS. **4**A and **4**B illustrate a third embodiment of a golf club shaft according to the present invention. In FIGS. **4**A and **4**B, a grip **11** is not illustrated. A shaft **40** of the third embodiment includes an outer shaft **12** and an inner shaft **14** disposed in a hollow portion of the outer shaft **12**. A void portion **16** is formed between the outer shaft **12** and the inner shaft **14**. In the third embodiment, the outer shaft **12** has such a hollow tapered conical shape that the diameter is gradually reduced toward the tip end. The inner shaft **14** has such a solid cylindrical shape that the diameter at the proximal end is the same as the diameter at the distal end. The outer shaft **12** and the inner shaft **14** have almost equal lengths. The outer shaft **12** may have the same length, outer diameter, and thickness of the wall portions as that in the first embodiment. The inner shaft **14** may have the same length and outer diameter as that in the first embodiment.

[0036] The void portion **16** has a width a, at the distal end, with a lower limit of preferably approximately 1 mm, particularly preferably approximately 2 mm, and an upper limit of preferably approximately 6 mm, particularly preferably approximately 4 mm. Moreover, the width a of the void portion **16** is gradually reduced from the proximal end of the golf club shaft toward the distal end thereof. Thus, the width a is smaller at the distal end of the golf club shaft than the proximal end thereof. This produces the same operation or effect as in the second embodiment.

[0037] In this embodiment, the functions and materials of a connecting member **18** and a vibration absorbing member **20**, the material and forming method of the outer shaft **12**, the material of the inner shaft **14**, and the like are the same as those in the first embodiment. Accordingly, the descriptions will be omitted. The inner shaft **14** can be formed by a known forming method using a fiber-reinforced resin or a metal.

Fourth Embodiment

[0038] FIGS. **5**A, **5**B, and **5**C illustrate a fourth embodiment of a golf club shaft according to the present invention. In FIGS. **5**A, **5**B, and **5**C, a grip **11** is not illustrated. A shaft **50** of the fourth embodiment includes an outer shaft **12** and an inner shaft **14** disposed in a hollow portion of the outer shaft **12**. A void portion **16** is formed between the outer shaft **12** and the inner shaft **14**. In the fourth embodiment, the outer shaft **12** has such a hollow tapered conical shape that the diameter is gradually reduced toward the tip end. The inner shaft **14** has on its proximal end side such a hollow tapered conical shape portion **12***a* that the diameter is gradually reduced toward the tip end, and has on its distal end side such a solid cylindrical shape portion **12***b* that the diameter at the proximal end is the same as the diameter at the distal end. The outer shaft **12** and the inner shaft **14** have almost equal lengths. The outer shaft **12** may have the same length, outer diameter, and thickness of the wall portions as that in the first embodiment. The inner shaft **14** may have the same length and outer diameter as that in the first embodiment.

[0039] The void portion **16** preferably has a width a, at the distal end, with a lower limit of preferably approximately 1 mm, particularly preferably approximately 2 mm, and an upper limit of preferably approximately 6 mm, particularly preferably approximately 4 mm. Moreover, the width a of the void portion **16** is gradually increased on the proximal end side from the proximal end of the golf club shaft toward the distal end thereof, and is gradually reduced on the distal end side from the proximal end of the golf club shaft toward the distal end thereof. This produces an operation or effect such that the inner shaft can be reduced in weight.

[0040] In the fourth embodiment, the functions and materials of a connecting member **18** and a vibration absorbing member **20**, the material and forming method of the outer shaft **12**, the material of the inner shaft **14**, and the like are the same as those in the first embodiment. Accordingly, the descriptions will be omitted. The inner shaft **14** can be formed by a known forming method using a fiber-reinforced resin or a metal.

[0041] It should be noted that the golf club shaft of the present invention is not limited to the above embodiments. For example, in the embodiments, the length of the outer shaft is equal to the length of the inner shaft; however, both of the shafts may have different lengths. In addition, in the embodiments, the inner shaft has a circular section, but may have other shapes such as a polygon.

[0042] Next, operations and effects of the shaft of the present invention will be described with reference to FIGS. **6** and **7**. FIG. **6** is an explanatory view showing how the shaft **40** of the third embodiment flexes when a golfer slow in head speed swings a golf club with the shaft. As shown in FIG. **6**, the outer shaft **12** flexes, but the inner shaft **14** does not flex at all or flexes little depending on the head speed. As a result, the shaft **40** is flexible and suitable for a golfer slow in head speed. The flexibility of the shaft **40** is utilized to increase the launch angle of a ball; thereby, the driving distance can be increased.

[0043] FIG. **7** is an explanatory view showing how the shaft **40** of the third embodiment flexes when a golfer fast in head speed swings the golf club with the shaft. As shown in FIG. **7**, both of the outer shaft **12** and the inner shaft **14** flex in accordance with the head speed, although the degree of the flexure varies depending on the head speed. As a result, the shaft **40** is stiff and suitable for a golfer fast in head speed. The stiffness of the shaft is utilized to increase the initial speed of a ball; thereby, the driving distance can be increased. Note that, in this case also, the outer shaft **12** plays a major role in the shaft **40**, while the inner shaft **14** plays a minor role.

[0044] Note that, although the shaft of the third embodiment is used to describe the operations and the effects of the shaft of the present invention, it would be easily understood by those skilled in the art that even the shafts in the other embodiments can exhibit the same operations and effects.

[0045] The descriptions have been given of the embodiments of the golf club shafts and the golf club according to the present invention. However, the present invention is not limited to these embodiments. Alterations and modifications apparent to those skilled in the art are included within the entire technical scope of the present invention.

What is claimed is:

1. A golf club shaft comprising:

an outer shaft having a hollow portion; and

an inner shaft disposed in the hollow portion of the outer shaft,

wherein a void portion is formed between the outer shaft and the inner shaft.

2. The golf club shaft according to claim **1**, wherein the void portion has a width of approximately 1 mm to approximately 6 mm at a distal end of the golf club shaft.

3. The golf club shaft according to any one of claims **1**, wherein a proximal end portion of the outer shaft is connected to a proximal end portion of the inner shaft through a connecting member.

4. The golf club shaft according to any one of claims **1**, wherein a vibration absorbing member is disposed in the void portion at a position between a distal end portion of the outer shaft and a distal end portion of the inner shaft.

5. The golf club shaft according to any one of claims **1**, wherein the outer shaft has a length equal to a length of the inner shaft.

6. The golf club shaft according to any one of claims **1**, wherein the void portion between the outer shaft and the inner shaft has a width larger at the distal end of the golf club shaft than a proximal end thereof.

7. The golf club shaft according to any one of claims **1**, wherein the void portion between the outer shaft and the inner shaft has a width smaller at the distal end of the golf club shaft than a proximal end thereof.

8. The golf club shaft according to any one of claims **1**, wherein the outer shaft is formed of a fiber-reinforced resin.

9. A golf club comprising the golf club shaft according to any one of claims **1**.

* * * * *