

5088735	February 1992	Shigetoh
5143374	September 1992	Shibasaki
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Foreign Patent Documents

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Claims

What is claimed is:

1. A golf club shaft, comprising: an elongated tube having a first diameter grip end tapering to a smaller second diameter head end, said tube formed as a composite from a first and second kind of circumferentially superimposed resin-impregnated unidirectional filamentary materials having different moduli of elasticity wherein;

said first diameter grip end of said tube comprises said first filamentary material having a high modulus of elasticity;

the remainder of said tube consists of said second filamentary material having a lower modulus of elasticity; and

said grip end of said tube has a lower degree of flexibility than the remainder of said tube.

2. A golf club shaft according to claim 1, wherein the length of said tube is in the range of 39 to 60 inches.

3. A golf club shaft according to claim 1, wherein said first filamentary material is selected from the group consisting of resin-impregnated carbon graphite filaments, boron filaments and mixtures of carbon and graphite filaments;

and said second filamentary material is selected from the group consisting of resin-impregnated glass fibers and filaments.

4. A method of making a golf club shaft having a grip end and head end, utilizing a plurality of plies formed into predetermined patterns from at least two different kinds of resin-impregnated unidirectional filamentary materials having different moduli of elasticity and a mandrel tapering from a wide end to a narrow end and having dimensions complimentary to the internal dimensions of said shaft, comprising the steps of:

(a) wrapping onto said mandrel a first ply of said shaft formed from a first resin-impregnated unidirectional filamentary material having a first modulus of elasticity, and having its filaments oriented at a first angle to the longitudinal axis of the mandrel;

(b) wrapping onto said first ply a second ply of substantially similar dimensions to said first ply, said second ply having its filaments oriented at a second angle to the longitudinal axis of the mandrel which is different from said first angle;

(c) wrapping onto said second ply a third ply formed from two resin-impregnated unidirectional filamentary materials spliced together, one material having a high modulus of elasticity and forming from about one third to two thirds of the length of said third ply starting from said narrow end, the other material having a relatively low modulus of elasticity, wherein the filaments of both materials are oriented substantially

parallel to the longitudinal axis of the mandrel;

(d) wrapping onto the third ply at said grip end a fourth ply which is longer than the length of said high modulus material of said third ply, said fourth ply being formed from resin-impregnated unidirectional filamentary material having a high modulus of elasticity, wherein the filaments are oriented substantially parallel to the longitudinal axis of said mandrel;

(e) wrapping onto said fourth ply a fifth ply formed from resin-impregnated unidirectional filamentary material, wherein the filaments are oriented substantially parallel to the longitudinal axis of the mandrel;

(f) applying sufficient heat and pressure to the wrapped plies to cure and harden the resin and form an integrated structure.

5. A method according to claim 4, further comprising, between steps (b) and (c), the step (b') of wrapping onto said second ply at said narrow end of said mandrel an additional ply covering less than one third the length of said shaft, said additional ply formed from resin-impregnated unidirectional filamentary material having a relatively low modulus of elasticity and having its filaments oriented substantially parallel to the longitudinal axis of said mandrel.

6. A method of making a golf club shaft from a plurality of plies formed into predetermined patterns from at least two different kinds of resin-impregnated unidirectional filamentary materials having different moduli of elasticity, and a mandrel tapering from a wide end to a narrow end and having dimensions complimentary to the internal dimensions of said shaft, comprising the steps of:

(a) aligning with the longitudinal axis of said mandrel the base of a first trapezoidal ply formed from a first resin-impregnated unidirectional filamentary material having a low modulus of elasticity, wherein the filaments are oriented at a first angle to the longitudinal axis of the ply, said ply having a substantially flat base of the length of the completed shaft, a relatively wide end substantially perpendicular to the base, a sloping side opposite the base, and a relatively narrow end opposite to said wide end and substantially perpendicular to said base, and wrapping said first ply onto said mandrel;

(b) aligning with the longitudinal axis of said mandrel the base of a second trapezoidal ply formed from said first filamentary material and having substantially similar dimensions as said first ply, wherein the filaments are oriented at a second angle to the longitudinal axis of said second ply, and wrapping said second ply onto the said ply;

(c) aligning with the longitudinal axis of said mandrel the base of a third trapezoidal ply formed from two resin-impregnated unidirectional filamentary materials spliced together, one material having a low modulus of elasticity and forming from about one third to two thirds of the length of said third ply starting from the wide end, the other material having a relatively low modulus of elasticity, wherein the filaments of both materials are oriented substantially parallel to the longitudinal axis of said third ply, said third ply having a substantially flat base of the length of said shaft, a relatively wide end substantially perpendicular to the base, a sloping side opposite the base, and a relatively narrow end opposite the wide end and substantially perpendicular to the base, and wrapping said third ply onto said second ply so that the filaments of said third ply are substantially parallel to the longitudinal axis of said mandrel;

(d) aligning with the longitudinal axis of said mandrel the base of a fourth trapezoidal ply formed from resin-impregnated unidirectional filamentary material having a high modulus of elasticity, wherein the filaments are oriented substantially parallel to the longitudinal axis of said fourth ply, said fourth ply having a substantially flat base longer than the length of the high modulus material in said third ply, a relatively wide end substantially perpendicular to the base, a sloping side opposite the base, and a relatively narrow end opposite the wide end and substantially perpendicular to the base, and wrapping said fourth ply onto said third ply at the wide end of said third ply so that the filaments of said fourth ply are substantially parallel to the longitudinal axis of the mandrel;

(e) aligning with the longitudinal axis of said mandrel the base of a fifth ply formed from resin-impregnated unidirectional filamentary material, wherein the filaments are oriented substantially parallel to the longitudinal axis of said fifth ply, said fifth ply being substantially rectangular and having a substantially flat

base of the length of said shaft, and wrapping said fifth ply onto the fourth and third plies, so that the filaments of said fifth ply are substantially parallel to the longitudinal axis of said mandrel;

(f) applying sufficient heat and pressure to the wrapped plies to cure and harden the resin and form an integrated structure.

7. A method according to claim 6, further comprising, between steps (b) and (c), the step (b') of aligning with the longitudinal axis of said mandrel the base of an additional trapezoidal ply formed from resin-impregnated unidirectional filamentary material having a low modulus of elasticity, wherein the filaments are oriented substantially parallel to the longitudinal axis of said additional ply, said additional ply having a substantially flat base of less than one third the length of said shaft, a first end, intermediate in width between the wide and narrow ends of the first and second plies, substantially perpendicular to the base, a shorter parallel side opposite the base, and a slanted end, and wrapping said additional ply onto the second ply at the narrow end of said second ply, so that the filaments of said additional ply are substantially parallel to the longitudinal axis of the mandrel.

8. A method according to claim 6, wherein the filaments of said first ply are oriented at an angle between 15.degree. and 45.degree. to the longitudinal axis of said first ply.

9. A method according to claim 6, wherein said plies are obtained by cutting from resin-impregnated unidirectional fiber cloths.

10. A golf club shaft made according to the method of claim 4.

11. A golf club shaft made according to the method of claim 6.

12. A golf club shaft, comprising: an elongated tube having a relatively large diameter grip end tapering to a relatively smaller diameter head end, said tube formed as a composite member comprising a pair of circumferentially superimposed layers of a resin-impregnated unidirectional filamentary material having a relatively low modulus of elasticity, wherein said layers have, respectively, fibers oriented in opposite angles between 15.degree. and 45.degree. to the longitudinal axis of said tube; a third layer circumferentially superimposed about said first pair of layers formed from two resin-impregnated unidirectional filamentary materials spliced together, one material having a relatively high modulus of elasticity and forming from one third to two thirds of the length of the tube starting from said grip end, the other having a relatively low modulus of elasticity, wherein the filaments of both materials are oriented substantially parallel to the longitudinal axis of said tube; a fourth layer circumferentially superimposed about said third layer at said grip end, longer than the length of the high modulus material in said third layer, formed from resin-impregnated unidirectional filamentary material having a relatively high modulus of elasticity, wherein the filaments are oriented substantially parallel to the longitudinal axis of the tube; and a fifth layer of the length of said shaft circumferentially superimposed about said third and fourth layers, formed from resin-impregnated unidirectional filamentary material having a relatively low modulus of elasticity, wherein the filaments are oriented substantially parallel to the longitudinal axis of said tube.

13. A golf shaft according to claim 12, further comprising, an additional layer circumferentially superimposed about said pair of layers at said head end, less than one third the length of said shaft formed from resin-impregnated unidirectional filamentary material having a relatively low modulus of elasticity and having the filaments of said additional layer oriented substantially parallel to the longitudinal axis of said tube.

14. A golf club, comprising:

a club head; and

a shaft, said shaft comprising:

an elongated tube having a relatively large diameter grip end tapering to a relatively smaller diameter head end, said tube formed as one composite member from at least two different kinds of resin-impregnated unidirectional filamentary material having different moduli of elasticity;

said relatively large diameter grip end of said tube consists of filamentary material having a relatively high modulus of elasticity; the remainder of said tube comprising filamentary material having a significantly lower modulus of elasticity;

wherein the grip end of said tube has a lower degree of flexibility than the remainder of said tube.

15. A golf club, comprising:

a club head; and

a shaft, said shaft comprising:

an elongated tube having a relatively large diameter grip end tapering to a relatively smaller diameter head end, said tube formed as one composite member comprising a pair of circumferentially superimposed layers of a resin-impregnated unidirectional filamentary material having a low modulus of elasticity, and wherein said layers have, respectively, fibers oriented at opposite angles between 15.degree. and 45.degree. to the longitudinal axis of said tube; a third layer circumferentially superimposed about said first pair of layers formed from two resin-impregnated unidirectional filamentary materials spliced together, one material having a low modulus of elasticity and forming from one third to two thirds of the length of said tube starting from said grip end, the other material having a relatively high modulus of elasticity, wherein the filaments of both materials are oriented substantially parallel to the longitudinal axis of said tube; a fourth layer circumferentially superimposed about said third layer at said grip end, longer than the length of said high modulus material in said third layer, formed from resin-impregnated unidirectional filamentary material having a relatively high modulus of elasticity, wherein said filaments of said fourth layer are oriented substantially parallel to the longitudinal axis of said tube; and a fifth layer of the length of said shaft circumferentially superimposed about said third and fourth layers, formed from resin-impregnated unidirectional filamentary material having a relatively low modulus of elasticity, wherein the filaments are oriented substantially parallel to the longitudinal axis of said tube.

Description

The present invention relates generally to golf club shafts, and more particularly to a composite golf club shaft having a high modulus of elasticity in the grip end of the shaft to enhance stiffness, and a low modulus of elasticity in the tip end of the shaft to provide flexibility, and to a method of manufacturing such a golf club shaft.

BACKGROUND OF THE INVENTION

The shaft of a golf club couples the golfer to the club head with which the golfer strikes the ball. The shaft is the primary component by which the golfer can manipulate the club head in executing the intended shot. In addition to performance or playability of a golf club, there are intangibles that influence a player's like or dislike of a particular product. Of these, the "feel" is of foremost concern. The "feel" is the capability of the golf club to reproduce the shot intended by the golfer, which relates to the confidence instilled in the golfer through his kinesthetic senses that he or she can produce the intended shot.

A golf club shaft may generally be described as a straight rod having a relatively larger diameter grip end, where a material by which the player holds the club is attached, tapering, either gradually or in discrete steps, to a relatively smaller diameter head end, where a club head is attached. Previous golf club shafts have been composed of wood, metal and composite materials.

The subject of the "feel" of a golf club is discussed in U.S. Pat. Nos. 4,319,750, 4,757,997 and 4,889,575, each of which is incorporated herein by reference. These previous patents are directed to golf shafts designed to provide improved playability and "feel". U.S. Pat. Nos. 4,757,997 and 4,889,575 disclose shafts composed of layers of woven and non-woven filamentary fibers. U.S. Pat. No. 4,319,750 discloses a composite shaft having a relatively flexible grip end and a relatively stiff head end.

It has now been discovered that an alternative configuration of composite materials may be used to produce a golf club shaft having improved performance while retaining the desirable characteristics that provide good "feel".

Accordingly, it is an object of the present invention to provide a golf club shaft with enhanced performance while retaining the desirable characteristics that provide good "feel".

Another object of the present invention is to provide a method for making such a golf club shaft.

Yet another object of the present invention is to provide a golf club incorporating such a golf club shaft.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out in the claims.

SUMMARY OF THE INVENTION

The present invention is directed to a golf club shaft comprising an elongated tube having grip with an initial diameter end tapering to a relatively smaller diameter head end formed as one composite member from at least two kinds of circumferentially superimposed resin-impregnated unidirectional filamentary materials having different moduli of elasticity. The larger diameter grip end of the tube comprises filamentary material having a first modulus of elasticity, while the remainder of the tube comprises filamentary material having a lower second modulus of elasticity. As such, the grip end of the tube has a relatively lower degree of flexibility than the remainder of the tube.

The present invention is further directed to a method of making a golf club shaft comprising obtaining a plurality of plies formed into predetermined patterns from at least two kinds of resin-impregnated unidirectional filamentary materials having different moduli of elasticity. The plies may be assembled on a mandrel tapering from a wide end to a narrow end and having dimensions complementary to the internal dimensions of the completed shaft as follows: A ply of the length of the completed shaft formed from a resin-impregnated unidirectional filamentary material having a relatively low modulus of elasticity, is wrapped onto a mandrel so that its filaments are oriented at an angle to the longitudinal axis of the mandrel. A second ply of the same dimensions as the first ply having its filaments oriented at an angle to the longitudinal axis of the mandrel opposite that of the first ply is then wrapped onto the first ply. An additional ply less than one third the length of the completed shaft, formed from resin-impregnated unidirectional filamentary material having a low modulus of elasticity and having its filaments oriented substantially parallel to the longitudinal axis of the mandrel, may optionally be wrapped onto the second ply at the narrow end of the mandrel in order to reinforce the tip of the shaft. A third ply formed from two resin-impregnated unidirectional filamentary materials spliced together, one material having a high modulus of elasticity and forming from one third to two thirds of the length of the ply starting from the grip end, the other having a relatively low modulus of elasticity, wherein the filaments of both materials are oriented substantially parallel to the longitudinal axis of the mandrel is then wrapped onto the second ply, and, if present, the tip reinforcement ply. Next, a fourth ply, one to three inches longer than the length of the high modulus material in the third ply, formed from resin-impregnated unidirectional filamentary material having a relatively high modulus of elasticity, wherein the filaments are oriented substantially parallel to the longitudinal axis of the mandrel is wrapped onto the third ply at the grip end. This provides additional stiffness to the grip end of the shaft and strengthens the splice joint in the third ply. A fifth ply formed from resin-impregnated unidirectional filamentary material, wherein the filaments are oriented substantially parallel to the longitudinal axis of the mandrel is wrapped onto the fourth and third plies in order to adjust the flex and to provide a finished appearance. Sufficient heat and pressure are applied to the wrapped plies to cure and harden the resin and form an finished integrated structure.

The present invention is also directed to a golf club comprising such a shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

with a suitable grip material such as leather or rubber,

and fixing a club head 63 to the tip end by applying a suitable adhesive and inserting the tip end into the hosel of a club head.

Since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modification and equivalents may fall within the scope of the invention.

The present invention has been described in terms of a preferred embodiment and is considered as illustrative only of the principles of the invention. The invention, however, is not limited to the embodiment depicted and described. Rather, the scope of the invention is defined by the appended claims.

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