A shaft with a reinforcing core is provided for use in a hockey stick that improves the stiffness to weight ratio and durability of the shaft compared to a traditional wood shaft yet costs substantially less than an all composite shaft.
HOCKEY STICK WITH REINFORCED SHAFT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to a provisional application, Ser. No. 60/217,193 filed Jul. 10, 2000.

FIELD OF THE INVENTION

[0002] The present invention relates generally to hockey sticks and more particularly to a graphite and wood construction for the shaft thereof that exhibits an improved stiffness to weight ratio and a method of making the same.

BACKGROUND OF THE INVENTION

[0003] The popularity of sporting events today has prompted many developments in sports equipment. In most sporting events there is a need to develop equipment that exhibits maximum performance with minimum manufacturing cost. One way of improving the equipment is through the use of new materials. Developments in manufacturing methods have also provided opportunities not only for product design, but also for cost reduction.

[0004] Hockey is one sport in which the equipment has continued to develop. Although the functional requirements of a hockey stick have not changed, the design and manufacturing methods have progressed and evolved with a wide variety of materials now being used in the industry.

[0005] A hockey stick shaft must be lightweight and have a strength sufficient to endure the stresses that arise in use. More particularly, it must be able to withstand the impacts that occur throughout the shaft due to stick to stick contact during play. The materials used in the construction of the shaft and its overall stiffness define the all important “feel” of the shaft. The shaft must be stiff, but provide sufficient flex and damping during wrist and slap shots for the player to maximize velocity, control and feedback from the shot.

[0006] Hockey stick shafts can be made from a variety of materials including wood, aluminum, plastic and composite materials such as fiberglass, graphite and Kevlar. Materials are usually selected for their physical properties and cost in an attempt to improve performance while maintaining an affordable price for the shaft. Composite shafts are generally more expensive and can have a lower durability, but are still popular because of their lightweight and superior stiffness. Wood shafts are relatively inexpensive and have good “feel”, but they are not especially light, stiff or durable. Aluminum shafts can have a relatively short life as they are prone to bending failure. Although wood shafts are available with graphite or fiberglass laminated outer layers that provide increased stiffness, they are heavier and more expensive than all wood shafts and still do not have the stiffness of composite shafts.

[0007] There continues to be a need for a hockey stick shaft that is relatively inexpensive, lightweight, stiff, durable and has a good “feel”.

SUMMARY OF THE INVENTION

[0008] One object of the present invention is to provide a shaft and a method of making the same which has a reinforcing core and exhibits an improved stiffness to weight ratio.

[0009] Another object of the present invention is to provide a shaft and method for making the same that exhibits increased durability while minimizing weight.

[0010] Another object of the present invention is to provide a shaft with an internal composite core at a cost substantially less than an all composite shaft. It is unique to the present invention that the composite core is stiffer and/or lighter than the material removed from the shaft to create the bore or channel to accept the core.

[0011] In particular, one embodiment of the present invention provides a hockey stick and method of making the same that includes a shaft. A composite member is provided within the interior of the shaft. The remainder of the shaft is preferably made of wood. The wooden portion is provided with one or more bores or channels which provide a volume within the interior of the shaft to receive the composite member. The composite member is preferably made of a fiber/resin composite such as graphite. Various designs or types of composite core configurations may be applied throughout the interior of the shaft. The presence of the composite core provides a stiffness to weight ratio not realizable in an all wood shaft or a shaft of wood with outer composite laminates, but retains the desirable “feel” of a wood shaft.

[0012] Although the present invention is directed to the manufacturing process and performance of a shaft for a hockey stick, similar techniques and manufacturing methods can be applied to various other sports equipment that includes shaft like embodiments such as lacrosse sticks, baseball bats, field hockey sticks and tennis rackets among others.

[0013] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0015] FIG. 1 is a perspective view of a first preferred embodiment of a hockey stick of the present invention showing the shaft in two pieces merely for the purposes of illustration and explanation;

[0016] FIG. 1a is a cross-sectional end view of the hockey stick of FIG. 1;

[0017] FIG. 2 is a cross-sectional side view of the hockey stick, taken along sectional line 2-2 of FIG. 1;

[0018] FIG. 3 is a cross-sectional view of the shaft, taken along sectional line 3-3 of FIG. 1;

[0019] FIG. 3a is a cross-sectional end view of the shaft of a second alternative preferred embodiment of the hockey stick of the present invention;

[0020] FIG. 4 is a cross-sectional end view of the shaft of a third alternative preferred embodiment of the hockey stick of the present invention;
FIG. 5 is a cross-sectional end view of the shaft of a fourth alternative preferred embodiment of the hockey stick of the present invention;

FIG. 6 is a cross-sectional end view of the shaft of a fifth alternative preferred embodiment of the hockey stick of the present invention;

FIG. 7 is a cross-sectional end view of the shaft of a sixth alternative preferred embodiment of the hockey stick of the present invention;

FIG. 8 is a cross-sectional side view of the shaft of FIG. 7, taken along sectional line 8-8 in FIG. 7;

FIG. 9 is a cross-sectional view of the shaft of a seventh alternative preferred embodiment of the hockey stick of the present invention;

FIG. 10 is an exploded end view showing the components of the shaft shown in FIG. 9;

FIG. 11 is a cross-sectional view of the shaft of eighth alternative preferred embodiment of the hockey stick of the present invention;

FIG. 12 is an exploded end view showing the components of the shaft shown in FIG. 11;

FIG. 13 is a perspective view of a wood panel substrate used in the manufacturing process of the present invention;

FIG. 14 is a perspective view of the wood panel substrate of FIG. 14 having composite inner portions provided; and

FIG. 15 is a perspective view of the manufacturing process of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following description of the preferred embodiments is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

Referring first to FIG. 1, a hockey stick 10 is shown having a shaft 12 and a blade 14. The shaft 12 of the hockey stick 10 has a first end 16 opposite a second end 18. The first end 16 of the shaft 12 is defined where the shaft 12 is coupled with the blade 14 of the hockey stick 10 (the shaft/blade interface). The second end 18 of the shaft 12 is defined opposite the shaft/blade interface 16 wherein the player grips the hockey shaft 12.

It is preferable that the shaft 12 of the hockey stick 10 has a cross-sectional rectangular geometry, as in traditional hockey sticks. However, it should be appreciated that cross-sectional shapes can vary in geometrical configuration depending on the preferred performance and manufacture of the hockey stick.

As seen in FIGS. 1 and 1a, the hockey stick 10 includes an outer portion 20 and an inner portion 22. The outer portion 20 preferably consists of wood while the inner portion 22 preferably consists of a composite. To accommodate the inner portion 22, a channel or bore 20a is provided through the body of the shaft 12. The inner portion 22 of the shaft 12 is provided within the channel/bore 20a and is surrounded by the outer portion 20 of the shaft.

The outer portion 20 of the shaft 12 is preferably made of aspen, although various types of wood or wood laminates having similar characteristics can be used. As will be apparent from the following description, there are numerous benefits to combining a wooden outer portion 20 with a composite inner portion 22. The benefits include reducing the weight of the stick, maintaining the desirable “feel” of a wood stick, and increasing the stiffness of the shaft 12.

With reference to FIG. 2, a longitudinal cross-sectional view of the interior construction of the shaft 12 is shown. As can be seen, the inner portion 22 of the shaft 12 is disposed within the outer portion 20. The size and shape of the inner portion 22 reflects the dimensions provided by the channel/bore 20a.

In the preferred embodiment, the inner portion 22 extends along the length of the shaft 12, thereby providing increased stiffness throughout various key points along the shaft 12, most importantly where maximum stresses develop. As seen in FIG. 2, the inner portion 22 extends throughout substantially the entire length of the shaft 12. It should be appreciated that the length of the inner portion 22 can vary, as well as be selectively distributed anywhere along the longitudinal axis CL of the shaft 12.

The inner portion 22 is preferably made of a carbon fiber/epoxy resin composite. The carbon fiber/epoxy resin composite is also known in the art as a “graphite composite”. Although graphite composite is the most preferable material for the inner portion 22, various other fibers such as glass or kevlar can be used in alternate embodiments of the present invention. Further, a metal core may also be used.

One of unique features of the inner portion 22 is the adaptability of the inner portion 22 to be manufactured to reflect the various needs of a hockey shaft 12. The carbon fiber/epoxy resin contains a plurality of fibers. The thickness and orientation of the fibers in the composite affect the degree of stiffness that the inner portion 22 exhibits. In order to obtain a specific stiffness, the fibers are preferably oriented parallel to the longitudinal center axis of the hockey stick shaft 12, indicated by line CL. The fibers of the composite can be oriented in a variety of directions to adjust the stiffness characteristics of the inner portion 22. Such degrees of change include but are not limited to, a rotation of the fibers ±45 degrees relative to the longitudinal center axis CL.

In addition to the orientation of the fibers, the positioning of the inner portion 22 within the shaft 12 provides varying degrees of stiffness depending on the quantity used and location of the inner portion 22 relative to the remainder of the shaft 12. The degree of stiffness further depends on the cross-sectional area and geometric configuration of the inner portion 22, as well as the length and distribution of the inner portion 22 throughout the shaft 12. Accordingly, various embodiments of the present invention provide a variety of stiffness characteristics to a hockey stick shaft 12 depending on the desired performance of the stick during play.

As can be seen in FIGS. 3 through 12, alternate cross-sectional views are shown of the composite shaft. Each figure represents an alternate embodiment or exploded view of an inner portion provided within an outer portion of a shaft. Although the manufacturing technique is basically
the same for each embodiment, slight variations are made in the process to obtain alternate types of inner portion configurations. In each embodiment like reference numerals are used to indicate like components but increased by 100 for clarity.

[0043] In particular, FIG. 3 illustrates an elevational cross-sectional view of a shaft 112 having a solid inner portion 122 disposed along the longitudinal center axis of the shaft 112. The solid inner portion 122 is preferably made of a graphite composite and is surrounded by a solid wooden outer portion 120. The solid composite inner portion 122 has a cross sectional shape that is substantially elliptical wherein the major axis is preferably aligned along the axis D-D. The solid inner portion 122 is placed within the shaft 112 following the removal of the corresponding wood portion of the shaft 112.

[0044] FIG. 3a shows a hollow elliptical shaped inner portion 222 disposed within the shaft 212 of the hockey stick. This particular alternate embodiment provides the maximum stiffness-to-weight ratio while maintaining a desirable low weight shaft 212. As previously stated with reference to the solid inner portion 122 of FIG. 3, the hollow elliptical inner portion 222 is most preferably made of a graphite composite. Alternate types of hollow shaped inner portions can be can be disposed within the wood outer portion 220 of a hockey stick, including the use of various types of metal tubing. The hollow elliptical configuration 222 of the inner portion 222 provides an increase in stiffness desirable for a composite hockey stick, while eliminating the added weight typically provided by a solid insert.

[0045] Although FIGS. 3 and 3a provide substantially elliptical shaped inner portions 122 and 222, respectively, alternate shaped inner portions can be used in order to obtain the desirable performance characteristics of the hockey stick. For example, a circular shaped inner portion can also be used.

[0046] FIGS. 4 through 7 illustrate alternate embodiments of a wood hockey shaft having an inner portion consisting of a different material. The inner portion can include a plurality of core elements, all of which are disposed along the longitudinal axis of the shaft. Each of the additional core elements provide unique stiffness characteristics to the wooden shaft of the hockey stick.

[0047] FIG. 4 provides a solid rectangular shaped composite inner portion 322 disposed along the longitudinal center axis of the shaft 312. In contrast to alternate embodiments, the substantially rectangular inner portion 322 provides increased stiffness towards the corners of the shaft 312. The solid rectangular inner portion 322 is provided within a wooden outer portion 320. As mentioned previously, it should be appreciated that the cross sectional shape can be selected from a variety of geometries, including, but not limited to a circle, a square or a rectangle.

[0048] FIG. 5 provides a cross-sectional view of a shaft 412 having an inner portion 422 comprised of five core elements 424a-424e. Each of the five core elements 424a, 424b, 424c, 424d, and 424e are made of select composites, metal rods or tubing, or combinations thereof. Most preferably the core elements 424a-424e are made of graphite composite. The plurality of core elements can be selected from a variety of shapes and sizes such that each core element can have a pre-selected cross section thereby providing a specified degree of stiffness to the shaft. The combination of the core elements provides an inner portion that exhibits an increased stiffness to the shaft of the hockey stick without adding unnecessary weight.

[0049] As can be seen in FIG. 5, the shaft is provided with a primary core element 424a, and four secondary core elements 424b, 424c, 424d, and 424e. The primary core element 424a is a hollow elliptical shaped core element, as previously suggested in FIG. 3a. The four secondary core elements 424b-424e are substantially the same shape and size as each other, although various modifications can be made to the configuration of each of the core elements 424b-424e. It is preferable that the cross-section of the secondary core elements 424b-424e are substantially circular such that rod or tube-like elements are provided, however it should be appreciated that the cross sections can be of any shape.

[0050] The secondary core elements 424b-424e are provided towards the periphery of the shaft 412, more particularly towards the outer four corners 413a-413d of the substantially rectangular shaped shaft 412. The primary core element 424a is disposed along the longitudinal center axis of the shaft 412. Although the primary core element 424a of the inner portion 422 is shown as a hollow elliptical shaped element, various configurations can be applied.

[0051] FIG. 6 demonstrates an inner portion 522 comprised of a plurality of substantially equal size core elements 524 surrounded by an outer wooden portion 520. The equal sized core elements 524 are disposed uniformly throughout the shaft 512 of the hockey stick. More particularly, FIG. 6 illustrates an embodiment of a shaft 512 having six core elements 524a-524f. The core elements 524a-524f are preferably made of a graphite composite, although various types of materials can be used as previously suggested. The plurality of core elements 524a-524f are distributed throughout the shaft 512 to support the stress that develops in the hockey stick. The core elements 524a-524f preferably consist of carbon-based rods. Various lengths of rods may be used during manufacture to obtain the desired stiffness-to-weight ratio.

[0052] FIG. 7 illustrates a sixth alternate embodiment wherein the cross section of the shaft 612 provides an inner portion 622 having a substantially I-shaped configuration surrounded by an outer wooden portion 620. As shown in FIG. 7, the I-shaped inner portion 622 is oriented with its major axis aligned with the major axis of the shaft 612. Various orientations of the I-shaped configuration 622 can be applied within the shaft 612, such as the I-shaped inner element 622 can be oriented orthogonal to the major axis of the shaft 612. Various orientations provide varying degrees of stiffness to the shaft 612.

[0053] With reference to FIG. 8, which is a cross-sectional view of FIG. 7 taken along line 8-8, a plurality of holes 625a-e can be formed in the center region of the I-shaped inner portion 622. The series of holes 625a-e are preferably left hollow to minimize the overall weight of the hockey stick. Although these holes are preferably left hollow, various types of composite could be added to provide additional stiffness to the shaft.

[0054] FIGS. 9 and 10 provide a seventh alternate embodiment of a shaft 712 having an outer wooden portion
720 and an inner composite portion 722. The outer wooden portion 720 is divided into a first section 720a and a second section 720b. The two sections 720a and 720b are joined at seam 723 provided along the minor axis of the shaft 712 by an adhesive. The inner portion 722 is shown as a substantially elliptical hollow composite, although various alternate types of inner portions are applicable. The two sections 720a and 720b of the outer portion 720 have protective side portions 725a and 725b on either side of the shaft 712. The protective side portions 725a and 725b may be comprised of wood, laminate, or alternate protective materials and can increase the stiffness of the shaft.

[0055] The exploded view, as shown in FIG. 10, illustrates the combination of the components that make up the shaft.

[0056] FIGS. 11 and 12 provide an eighth alternate embodiment and an exploded view of a shaft 812 having an outer wooden portion 820 and an inner composite portion 822. As previously described in FIG. 9, the outer wooden portion 820 is divided into a first section 820a and a second section 820b. Contrary to FIG. 9, the two sections 820a and 820b are joined at seam 823 provided along the major axis of the shaft 812 by an adhesive. According to the preferred embodiment, the inner portion 822 is shown as a substantially elliptical hollow composite, although various alternate types of inner portions are applicable. Further contrary to FIGS. 9 and 10, protective side portions are not provided. This particular feature may be optionally applied based on the specific needs and manufacturing of the shaft.

[0057] A manufacturing technique used to obtain the various alternate embodiments of the composite shaft will now be described. FIGS. 13 through 15 demonstrate the various stages in the manufacturing process.

[0058] As can be seen in FIG. 13, the length of the first wood piece 1000a used is substantially the same as the desired length of the shaft, whereas the width is sufficient enough to yield approximately six shafts. The wood used in the manufacturing method is preferably aspen. The manufacturing method involves machining a plurality of grooves or channels 1021a within a first piece of wood 1000a thereby providing the first section 1020a of the outer portion 1020 of the shaft 1012. A router is typically used to obtain the plurality of channels, although alternate techniques may be applied. Although various shaped grooves or channels 1021a may be provided, according to each of the alternate embodiments previously described, the most preferable are semi-elliptical shaped grooves 1021a.

[0059] According to FIG. 14, a plurality of composite inner portions 1022 are placed within the semi-elliptical channels 1021a provided by the first piece of wood 1000a.

[0060] A second piece of wood 1000b, as shown in FIG. 15, is provided having complimentary semi-elliptical shaped channels or grooves 1021b and positioned relative to the first piece of wood 1000a having the channels 1021a that contain the composite inner portions 1022. The second piece of wood 1000b provides the second section 1020b of the outer portion 1020.

[0061] Prior to securing the planar surfaces of the two wood panels 1000a and 1000b together, a degreasing or cleaning solvent can be optionally used to enhance the bonding characteristics of an adhesive. A multi-purpose adhesive-like material, such as an epoxy, is applied to the two wood panels 1000a and 1000b to secure the two panels together. Adhesive is also applied to the wood surfaces that mate with the inner portion 1022. Optionally, adhesive may also be applied to outer surface of the inner portion 1022. Following the application of the adhesive to the planar surfaces of the two wood panels 1000a and 1000b, the second piece of wood 1000b is disposed opposite to the first panel of wood 1000a, thereby enclosing the inner portions 1022 provided within the first piece of wood 1000a. Once the two wood panels 1000a and 1000b are positioned opposite one another, pressure is applied to the external surface of the panels thereby setting the adhesive and securing the two wood panels 1000a and 1000b together. The wood pieces 1000a and 1000b having approximately six inner portions 1022 are then split along the dotted lines, as indicated in FIG. 15, to provide approximately six hockey sticks.

[0063] Alternate methods of setting the two shaft sections together can include but are not limited to the application of pressure and heat together, heat alone or pressure alone. Further, shafts may be made individually if desired.

[0064] Now referring back to FIGS. 9-12 in combination with FIGS. 13-15, alternate approaches to preparing the composite shaft according to the preferred method of manufacturing are demonstrated.

[0065] As previously described, a plurality of semi-elliptical shaped grooves, more specifically six, are provided by a router in the wood pieces. It should be appreciated that the router can form a channel having a variety of shapes, including but not limited to, a semi-circular, semi-rectangular, and semi-triangular configurations.

[0066] The router can be employed to provide a deep channel 721 as seen FIG. 10, such that the elliptical shaped inner portion 722 is sandwiched with a seam along the minor axis of the resulting shaft. Alternatively, the router can be employed to provide a shallow channel 821 as seen in FIG. 12, such that the elliptical shaped inner portion 822 is sandwiched within a seam along the major axis of the resulting shaft. Although both techniques can be used, the most preferable method of manufacturing the composite shaft is by scaling the two shaft sections along the major axis, as shown in FIGS. 11 and 12.

[0067] Although the preferred method of manufacturing is provided, alternate methods of manufacturing such as boring channels through a solid wood shaft and telescopically inserting the composite core element within the shaft can be applied.

[0068] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

What is claimed is:

1. A shaft-like apparatus for playing sports comprising:
an outer portion formed of a first material; and
a core portion formed of a second material disposed within said outer portion wherein said core portion is at
least one of stiffer and lighter than a material removed from said outer portion to accommodate said core portion.

2. The apparatus according to claim 1 wherein said outer portion comprises wood.

3. The apparatus according to claim 2 further comprising a plurality of side portions disposed adjacent to said outer portion.

4. The apparatus according to claim 3 wherein said plurality of side portions comprise composite laminates.

5. The apparatus according to claim 1 wherein said outer portion includes a first section secured to a second section along a longitudinal axis.

6. The apparatus according to claim 5 wherein said first section and said second section are secured along a major axis of said outer portion.

7. The apparatus according to claim 1 wherein said core portion comprises a composite material.

8. The apparatus according to claim 7 wherein said composite material comprises graphite composite.

9. The apparatus according to claim 1 wherein said core portion comprises metal.

10. The apparatus according to claim 1 wherein said core portion comprises a hollow tube.

11. The apparatus according to claim 10 wherein said hollow tube comprises metal.

12. The apparatus according to claim 1 wherein said core portion has an elliptical cross-sectional configuration.

13. The apparatus according to claim 1 wherein said core portion further comprises a plurality of core elements distributed within said outer portion.

14. The apparatus according to claim 1 wherein said core portion has a rectangular cross-sectional configuration.

15. The apparatus according to claim 1 wherein said core portion has an l-shaped cross-sectional configuration.

16. The apparatus according to claim 1 wherein said core portion has transverse bores formed therethrough.

17. A shaft-like apparatus for playing sports comprising: an outer portion formed of a first material; and an elliptical core portion formed of a second material axially disposed within said outer portion.

18. The apparatus according to claim 17 wherein said outer portion comprises wood.

19. The apparatus according to claim 17 further comprising a plurality of side portions disposed adjacent to said outer portion.

20. The apparatus according to claim 19 wherein said plurality of side portions comprise composite laminates.

21. The apparatus according to claim 17 wherein said core portion comprises composite.

22. The apparatus according to claim 17 wherein said outer portion comprises two sections.

23. The apparatus according to claim 17 wherein said core portion is hollow.

24. A hockey stick comprising:

a blade; and

a shaft coupled to said blade;

wherein said shaft of said hockey stick includes a wooden outer portion and a composite core portion.

25. The apparatus according to claim 24 further comprising a plurality of side portions disposed adjacent to said outer portion.

26. The apparatus according to claim 25 wherein said plurality of side portions comprise composite laminates.

27. The hockey stick according to claim 24 wherein said outer portion includes a first section secured to a second section along a longitudinal axis of said shaft.

28. The hockey stick according to claim 27 wherein said first section and said second section are secured along a major axis of said shaft.

29. The hockey stick according to claim 24 wherein said core portion has a substantially ellipsoidal configuration.

30. The hockey stick according to claim 29 wherein said core portion is hollow.