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Lacey et al.

(54) **REINFORCED COMPOSITE GAME STICK HANDLE**

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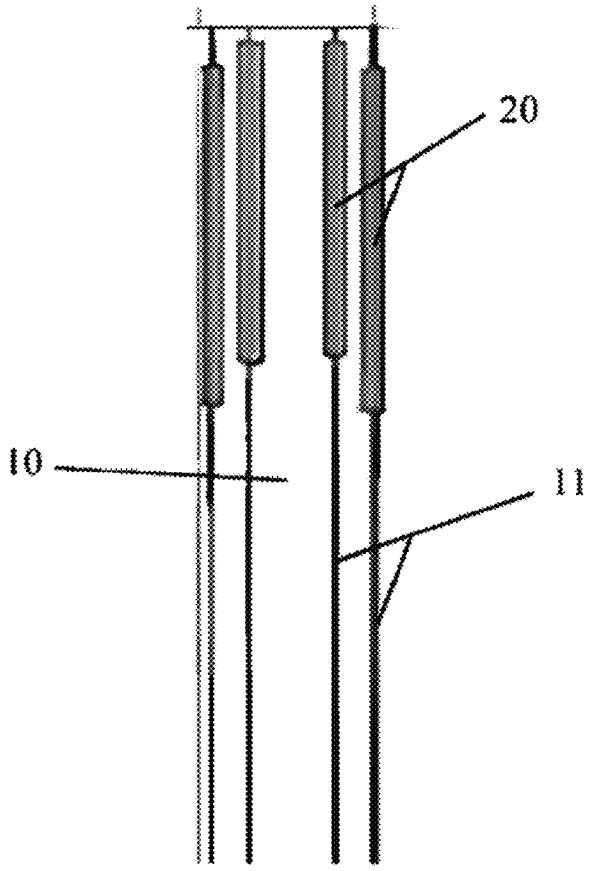
(57) **ABSTRACT**

An improved lacrosse stick shaft for attachment to a lacrosse stick head is provided. The stick is formed from a composite base shaft body with reinforcement features embedded or adhered to the surface thereof at selected locations to improve the resistance of the shaft to impacts and breakage without adding significant weight. The reinforcement features may take the form of rings of varying heights surrounding the entire handle at various longitudinal locations. In another preferred embodiment, the reinforcement features line selected edges of the shaft in a longitudinal direction where adjacent facets forming the cross-sectional shape of the shaft meet, or form a spiral along all or part of the length of the shaft. In yet another preferred embodiment, the reinforcement features are plates adhered to vulnerable areas of the shaft. The lacrosse stick herein described is advantageously used for both men's and women's lacrosse.



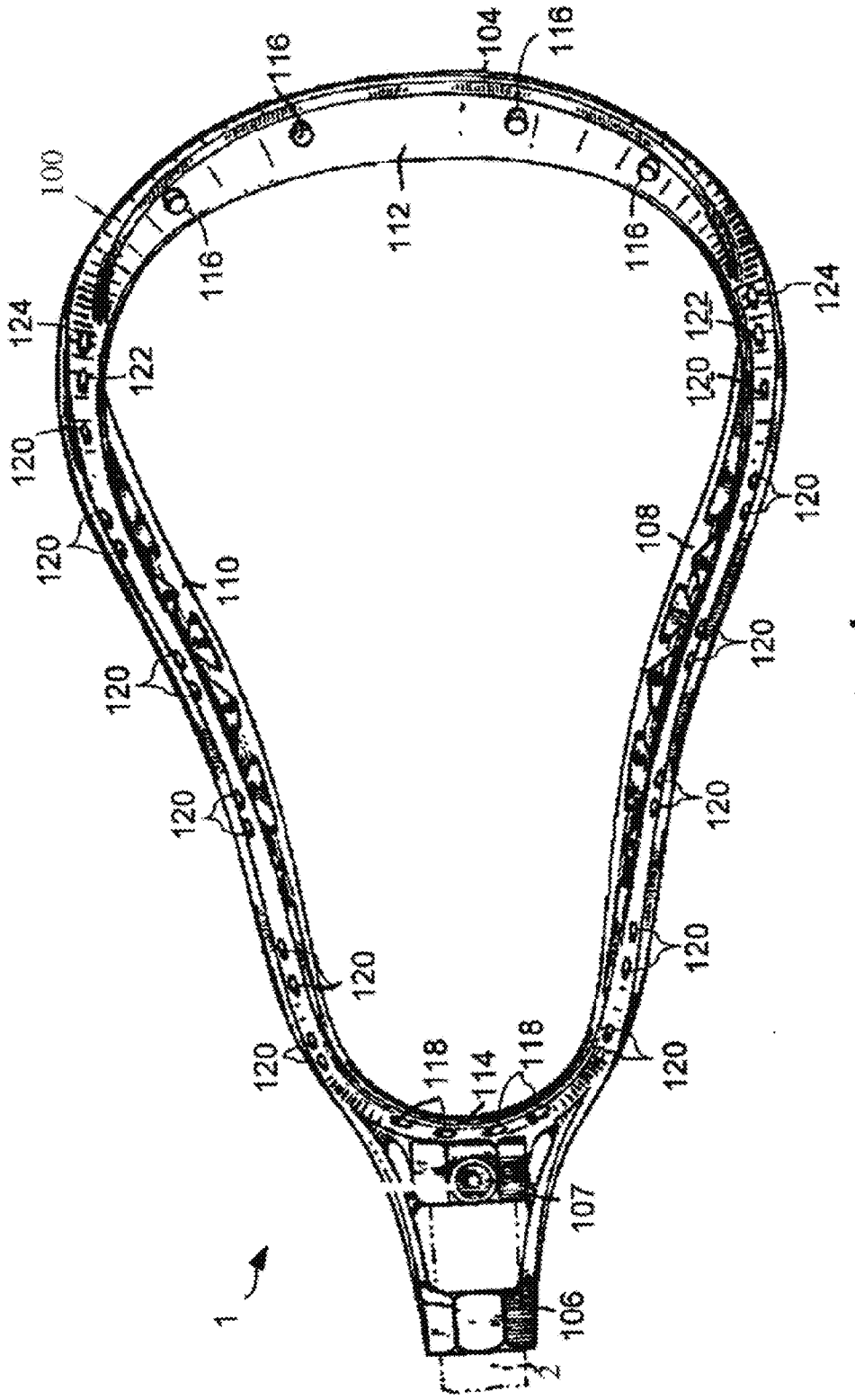


Fig. 1
(PRIOR ART)

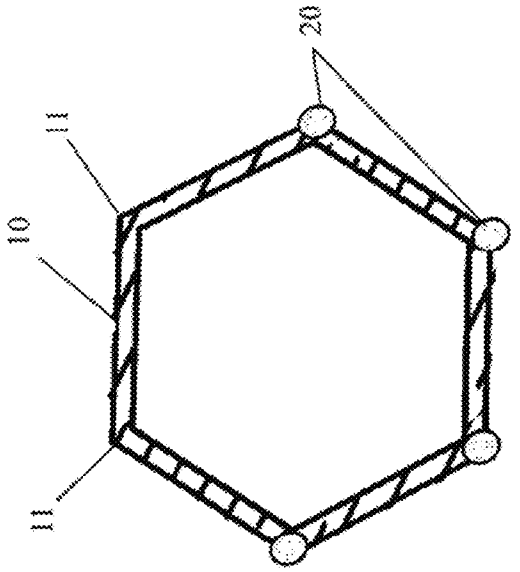


FIG. 4

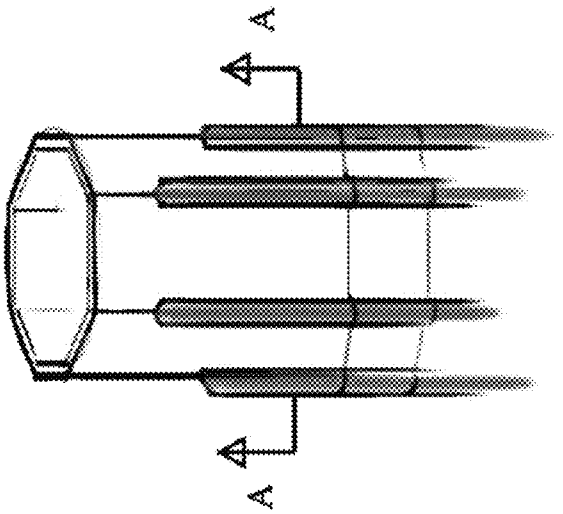


FIG. 3

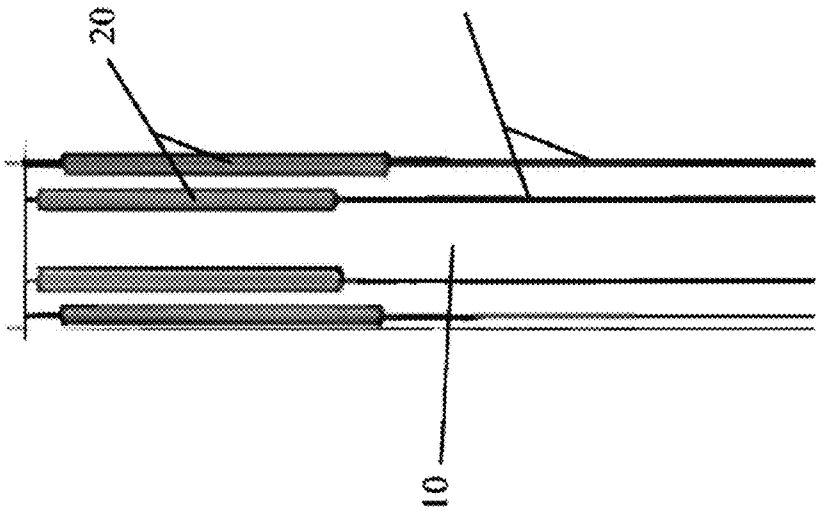


FIG. 2

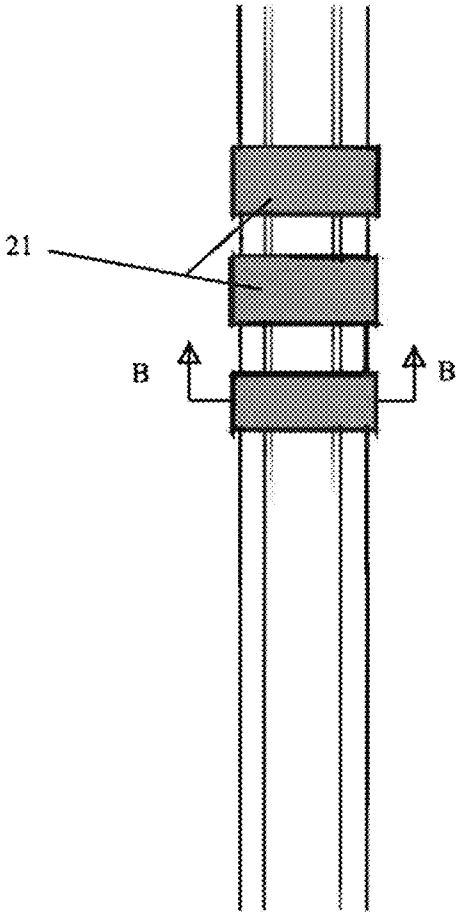


FIG. 5

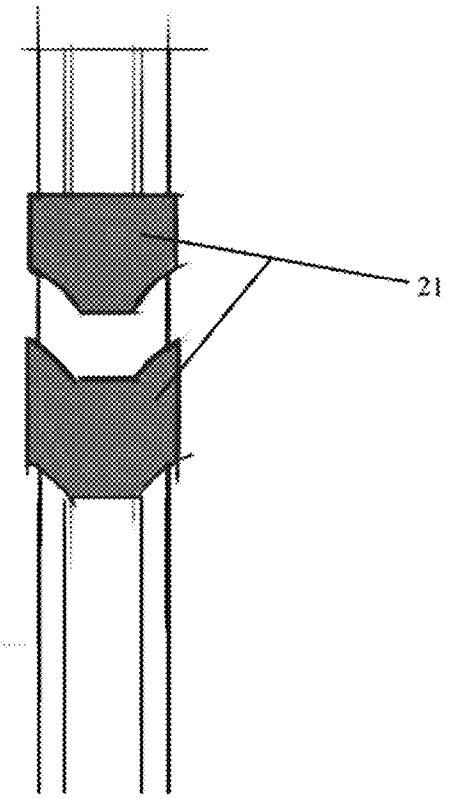


FIG. 6

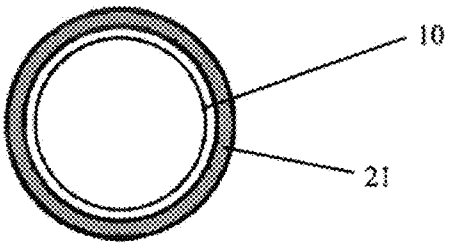


FIG. 7

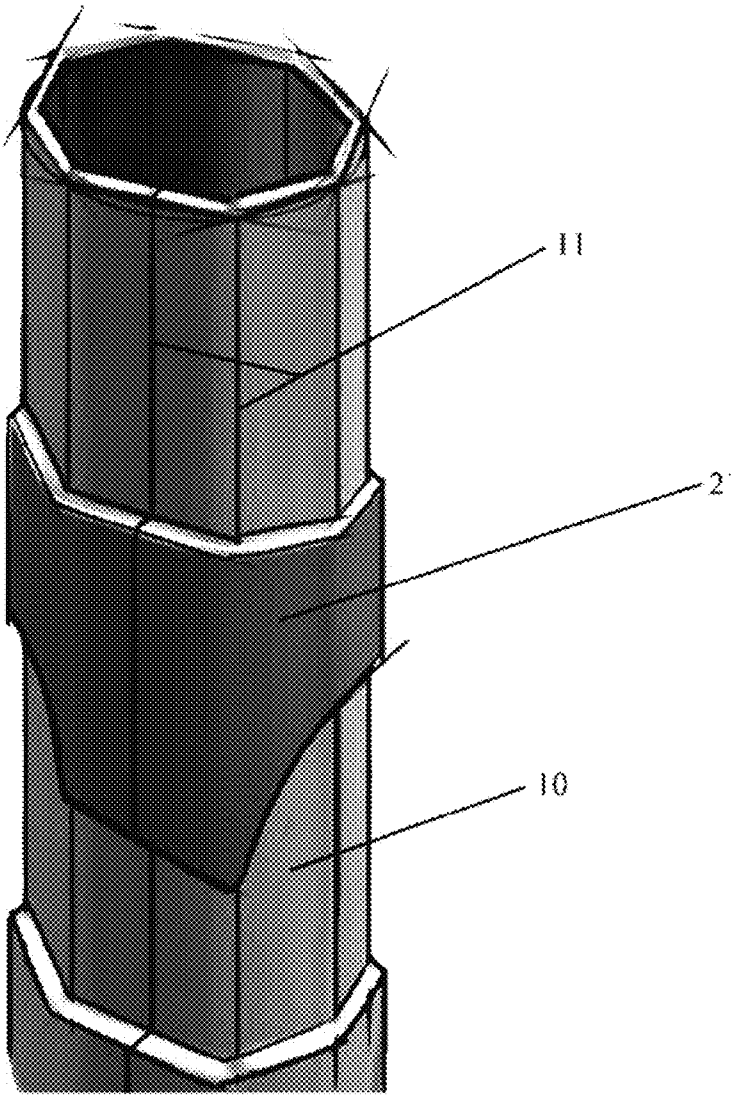


FIG. 8

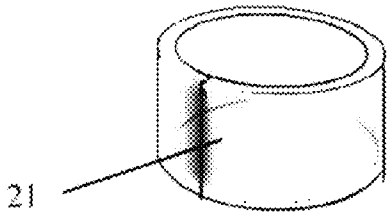


FIG. 9

FIG. 10

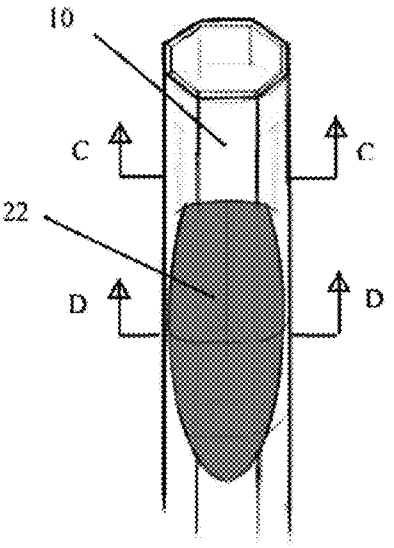


FIG. 11

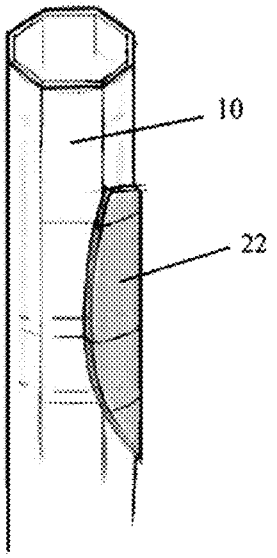


FIG. 12

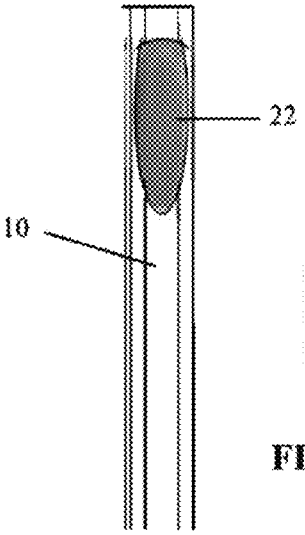


FIG. 13a

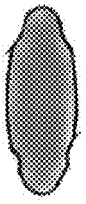


FIG. 13b

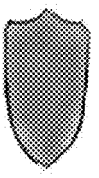


FIG. 13c

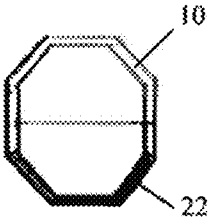


FIG. 14a

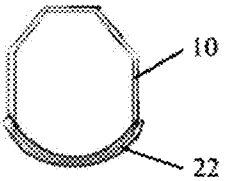


FIG. 14b

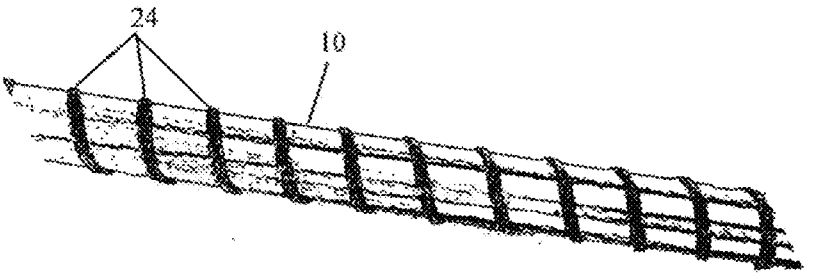


FIG. 15

REINFORCED COMPOSITE GAME STICK HANDLE

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] The present application derives priority from U.S. Provisional Patent Application Ser. No. 62/108,119 filed 27 Jan. 2015, and is a continuation of U.S. application Ser. No. 13/550,991 filed on 17 Jul. 2012 (which is a continuation in part of U.S. application Ser. No. 12/578,044 filed on 13 Oct. 2009 (abandoned)).

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates generally to sporting equipment, and more specifically, to an improved handle for a game stick designed for impact, such as a lacrosse or ice hockey stick.

[0004] 2. Description of the Background

[0005] The game of lacrosse is played using sticks comprising an elongate handle that attaches at one end to a head. Netting is strung or attached across the head to define a pocket for receiving a ball. A prior art lacrosse stick **1** is shown in FIG. **1** comprising a handle **2** represented by a dashed line joined to a head **100**. Head **100** generally includes a generally V-shaped frame having two sidewalls **108**, **110** joined by a stop member **114** at the end narrow end of the "V," nearest the shaft **2**. A transverse wall (or "scoop") **112** joins the sidewalls **108**, **110** at the open end of the "V." Strings (not shown) are strung between sidewalls **108**, **110** and between stop member **114** and scoop **112** to form a pocket in which a lacrosse ball can be caught or carried.

[0006] The handle **2** joins the head **100** at one end where it is received in a socket **106** formed in the stop member **114**. The handle **2** passes through the socket **106** and a screw or other fastener is placed through stop member **114** to secure handle **2** to head **100**.

[0007] During a lacrosse game, each player uses the handle **2** of his or her lacrosse stick to control the motion of the head **100** in order to perform the necessary functions of game play. The player must perform maneuvers such as scooping the ball from the ground into the pocket, cradling the ball in the pocket, throwing a ball from the pocket to another player or shooting the ball towards a goal, performing a stick check wherein one player uses part of his stick to contact the handle, head or body of another player, etc. Therefore, a lacrosse stick, which comprises a head, handle and pocket component, must be strong enough to withstand repeated impact with other sticks, other players, other equipment or the ground, but must be maneuverable enough to allow the player to lift it above his or her head, move it quickly from side to side, perform a throwing motion, and run with it at top speed. In addition, lacrosse sticks must be able to withstand vibrations caused by impacts during the game.

[0008] With a few minor exceptions, the only legal way for the player to contact the ball during a lacrosse game is with his or her stick. The lacrosse stick therefore serves as an extension of a player's body during game play. Due to the importance of the stick to the player's ability to play lacrosse, a player's level of comfort with his or her stick is very important. Lacrosse players are also called upon to perform various different maneuvers in rapid succession, often requiring the player to quickly adjust his or her hand position on the handle to transition between, for example, executing a stick check and catching the ball. For effective stick handling, a lacrosse player needs to maintain, a sure grip and a precise tactile feel for the stick. A precise tactile feel is important for players to be able to move their hands quickly along handle **2** to reposition them and to know where his or her hands are relative to various portions of the handle at all times. Raised features on the handle **2** give a tactile impression that can be used to index hand movement. A firm grip on the handle is important in order to execute maneuvers and to forcefully throw or shoot the ball.

[0009] For both offensive and defensive players on the lacrosse field, stick checking is an important technique used to attempt to force an opposing player to relinquish control of the ball. As described above, stick checking requires a player to use his or her stick to forcefully contact the stick of an opposing player to try to jar the ball loose from the opposing player's pocket. Another instance in which forceful contact between sticks of one or more players can occur is when one player attempts to block a shot or pass by another player by putting his or her stick in the path of the opposing player's stick. Forceful contact between a lacrosse stick and the stick, helmet, or other portion of another player's body, or between a lacrosse stick and another object such as a goal post, may also occur by accident or when a player makes an illegal maneuver during game play or practice.

[0010] Such impacts between a stick and another object may be forceful enough to cause the stick, and particularly the handle, to crack, shatter, or break. Broken lacrosse sticks are dangerous both during game play and in general, as breakage may result in sharp fragments or raw edges that may cut or otherwise injure those nearby. Also, of course, sticks with a higher risk of breakage are undesirable for players due to the risk that they will have to replace a broken stick during game play and due to the increased expense of purchasing additional sticks. In addition to a full break in which one part of the stick is separated from another part due to the force of an impact or the repeated force of many impacts or vibrations, breakage may comprise cracks, namely, delamination between pre-impregnated composite layers or microstructure cracking in impacted areas of the handle, that result in surface imperfections, weaken the handle, and over time may lead to complete failure. Metal stick handles may also dent upon the application of force, which negatively impacts the strength and handling characteristics of the stick as a whole.

[0011] Because the ball is located in the pocket of a player's stick when that player has control over the ball, most stick check maneuvers are focused on the upper portion of the handle proximate its connection to the head. Even though cross checking is not explicitly legal, it is nevertheless common in men's lacrosse and can cause denting or bending in the middle portion of the stick handle when contacting the opponent's hard padding or stick. An impact to a player's stick handle in this area is most likely to cause a ball in the pocket of that stick to be jolted loose. In addition, the most common hand positions used by a lacrosse player when he or she is running with the ball in his or her stick are (1) the dominant hand placed at the top of the stick near its connection to the pocket and the non-dominant hand loose to fend off attacks by opposing players, (2) both hands spread out along the length of the lacrosse stick, with one hand (typically the dominant hand) placed at the top of the stick and the non-dominant hand placed closer to the bottom of the stick; or 3) both hands in the bottom half of the stick.

[0012] Both positions 1-2 leave the middle portion of the handle between the head and capping member **4** open to be impacted by an opposing player in an attempt to vibrate the ball out of the offensive player's pocket or to slow or halt the offensive player's progress down the field. Position **3** leaves the upper half of the stick handle exposed.

[0013] Of the several types of materials commonly used to manufacture lacrosse stick handles, catastrophic breakage is most common in handles referred to as "composite" handles, which for purposes of this disclosure refer to carbon fiber-reinforced polymer, carbon fiber-reinforced plastic or carbon fiber-reinforced thermoplastic (CFRP, CRP, CFRTP or often simply carbon fiber, or even carbon), in which the binding polymer may be a thermoset resin such as epoxy, although other thermoset or thermoplastic polymers, such as polyester, vinyl ester or nylon, may be used. The composite handles of the disclosure may contain other fibers, such as aramid e.g. basalt, Kevlar™, Twaron™, aluminium, Ultra-high-molecular-weight polyethylene (UHMWPE) or glass fibers, as well as carbon fiber. The properties of the final CFRP product can also be affected by additives introduced to the binding matrix (the resin). One additive may be silica, but other additives such as rubber and carbon nanotubes can also be used. The composite material of the disclosure may also be graphite-reinforced polymer or reinforced plastic where, for example, a plastic base is reinforced with plastic fibers such as PP or PET polymers.

[0014] Some major advantages of lacrosse handles formed from such composite materials are its extreme light weight, control over flex properties, and good gripping characteristics. Unlike lacrosse handles made from metals or metal alloys, composite handles do not feel as cold to the player's hands under cold weather conditions, or as hot in hot weather conditions. Handles made from titanium or aluminum alloys typically do have these drawbacks and are also not as light weight as a standard composite handle. However, titanium or aluminum alloy handles feature the benefit of improved durability and ease of manufacturing over the conventional composite handle.

[0015] Applicants have determined that certain sections on a lacrosse stick handle are more vulnerable to failure, and, as described above, because certain areas of the lacrosse stick handle are more often subjected to forceful impacts than other sections. This makes it conceivable to design a lacrosse stick handle with variable material properties along its length, the material properties varying as a function of desired performance characteristics. More specifically, it would be advantageous to provide a lacrosse stick wherein material strength, weight and other characteristics are variable along the length of the handle as a function of quantitative performance characteristics.

[0016] Herein disclosed is a lacrosse stick handle and an efficient method for making same that is both light weight and exhibits good gripping characteristics, but also possesses improved strength and durability characteristics relative to prior art composite handles.

SUMMARY OF THE INVENTION

[0017] Accordingly, it is an object of the invention to provide an improved lacrosse stick handle that combines low overall weight with dent resistance, toughness, high stiffness, and geometric flexibility.

[0018] It is another object to provide a lacrosse stick handle with variable material properties along its length that vary as a function of desired performance characteristics, particularly wherein material strength, weight and other characteristics are varied in correspondence to anticipated performance requirements.

[0019] It is also an object of the present invention to provide a method of manufacturing an improved lacrosse stick which embeds multiple materials in the same handle body to take advantage of beneficial properties of both composite and metal or metal alloy materials at predetermined handle locations. The above features and benefits are achieved with a composite base handle body having reinforcement features selectively embedded in or applied to the surface thereof to provide additional protection against impact that may crack or shatter an all-composite handle. Methods to manufacture the composite handles of the disclosure may include molding, vacuum bagging, compression molding and filament winding, all of which methods are known in the art. The replacement of an all-metal handle minimizes denting and incremental weakening of handles constructed of metal and metal alloy materials.

[0020] For a more complete understanding of the invention, its objects, and advantages, refer to the remaining specification and to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Other objects, features, and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiment and certain modifications thereof, in which:

[0022] FIG. **1** illustrates a front view of a prior art lacrosse stick head.

[0023] FIG. **2** illustrates a front view of the improved lacrosse stick handle according to the present invention.

[0024] FIG. **3** illustrates a front perspective view of the improved lacrosse stick handle as in FIG. **2**.

[0025] FIG. **4** illustrates a top-perspective cross-sectional view taken along line A-A of FIG. **3**.

[0026] FIG. **5** illustrates a front view of the improved lacrosse stick handle according to another embodiment of the present invention.

[0027] FIG. **6** illustrates a front view of the improved lacrosse stick handle according to another embodiment of the present invention.

[0028] FIG. **7** illustrates a cross-sectional view taken along line B-B of FIG. **5** (wall thickness is not to actual scale).

[0029] FIG. **8** illustrates a front perspective view of the improved lacrosse stick as in FIG. **6**.

[0030] FIG. **9** illustrates a perspective view of the metal feature **21** as shown in FIG. **5**.

[0031] FIG. **10** illustrates a perspective view of the metal feature **21** according to another embodiment of the present invention.

[0032] FIG. **11** illustrates a front perspective view of the improved lacrosse stick according to yet another embodiment of the present invention.

[0033] FIG. **12** illustrates a front perspective view of the improved lacrosse stick according to yet another embodiment of the present invention.

[0034] FIG. **13***a* illustrates a front perspective view of the improved lacrosse stick according to yet another embodiment of the present invention.

[0035] FIG. **13***b* illustrates a front view of another embodiment of the metal feature according to the present invention.

[0036] FIG. **13***c* illustrates a front view of another embodiment of the metal feature according to the present invention.

[0037] FIG. **14***a* illustrates a cross-sectional view of the lacrosse stick according to the present invention taken along line C-C of FIG. **11**.

[0038] FIG. **14***b* illustrates a cross-sectional view of the lacrosse stick according to the present invention taken along line D-D of FIG. **11**.

[0039] FIG. **15** illustrates a side perspective view of the improved lacrosse stick according to yet another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0040] In general, the improved lacrosse stick according to the present invention is a shaft formed mainly or entirely from a composite material with reinforcement features (e.g. metal, plastic) overlaid, inlaid, or otherwise embedded or attached to the composite shaft at strategic points to provide enhanced impact resistance and strength characteristics without substantially increasing the overall weight of the stick. In some embodiments, reinforcement features take the form of "shield" plates or rings placed in strategic areas of the stick. In other embodiments the metal features may be in the form of parallel ribs or spiral wires also in strategically-chosen locations.

[0041] With collective reference to FIGS. **2-4**, a first embodiment of the present invention is shown. FIG. **2** depicts the main body portion **10** of handle **100**, which may possibly be formed of any hard polymer plastic material, but is preferably formed of any of a variety of composite materials known in the art, and most preferably formed from a high modulus carbon fiber with epoxy resin. As shown in FIG. **4**, the main body portion **10** of handle **100** may be a hollow tubular member with an octagonal cross section defining eight adjacent facets and eight corners, or "joints" **11**. Handle body **10** may alternatively have any cross-sectional shape known in the art, such as round, tear-drop, asymmetrical, and/or oval.

[0042] FIGS. **2-3** further depict metal reinforcement features **20**, which in one embodiment are strategically placed parallel to each other at the corners, or "joints" **11**, between one or more adjacent facets of the octagonal-shaped handle body **10**. In a preferred embodiment, four reinforcement features **20** are situated only on a top portion of the handle body **10** on four adjacent joints **11** between facets as shown in FIGS. **2** and **4**. The reinforcement features **20** preferably extend along a top portion of the handle body **10**, most preferably along at least the upper third thereof to protect the upper third of the stick **10** (most likely to be impacted by an opposing player in an attempt to vibrate the ball out of the offensive player's pocket or to slow or halt the offensive player's progress down the field). The reinforcement features **20** may alternatively extend along the upper half of the stick **10** for women's lacrosse, and may, if desired, extend along both the upper third and middle third to protect the upper two-thirds of the stick **10**. The joints **11** onto which reinforcement features **20** are placed, as described in further detail below, may be chosen to be those that would comprise the top side of the handle **100**, i.e. those on the same side of handle **100** as the open face of the lacrosse stick pocket where the ball would be received. This construction would advantageously provide additional protection to the composite handle body **10** from impacts aimed at the top, front portion of the stick, where stick checks and the like are often aimed in an attempt to dislodge the ball from the pocket. The front and side facing facets of body **10** are also more likely to receive impact forces from the sticks of opposing players and from other objects during game play because they are typically facing away from the player's body during throwing and shooting maneuvers in order to enable the ball to be released from the open side of the pocket. A very high percentage of handle denting occurs on the front and side corners of the handle and so these are most critical for reinforcement, in accordance with the invention.

[0043] As shown in FIG. **2**, reinforcement features **20** preferably begin at a top end of the stick body **10** proximate the socket **106** (as shown in prior art FIG. **1**) and extend some distance down the length of the body **10**, terminating before reaching the bottom end of the stick body **10** proximate capping member **4**. Reinforcement features **20** may extend anywhere along the longitudinal dimension of stick body **10**, and more preferably extend between 2-12 inches from the top end of body **10**. As shown in FIG. **2**, the locations of independent reinforcement features **20** may be staggered along the longitudinal dimension of body **10** such that the reinforcement features **20** on the joints **11** abutting that facet of body **10** that is perpendicular to the front of the stick body **10** may be seated closer to socket **106** of body **10** that those reinforcement features on adjacent joints. Reinforcement features **20** may all have the same length, or the length and locations of individual reinforcement features **20** may vary based on player or design preference. For example, sticks used by offensive players may have reinforcement features **20** situated closer to the socket **106** than those sticks used by defensive players to better guard against stick checks aimed at the pocket or socket area of the stick when offensive players are passing or making shots on goal. Although not shown in FIGS. **2-4**, reinforcement features **20** may also be located in an area near the longitudinal middle of stick body **10**, or roughly in between socket **106** and capping member **4**, to strengthen composite body **10** against stick checks in this area of the stick as described above. Additionally, reinforcement features **20** need not be confined solely to the corners, but could alternatively be located on the flat faces of the stick handle for both composite protection and player feel.

[0044] A top-perspective cross sectional view of body **10** along line A-A, containing reinforcement features **20**, is shown in FIG. **4**. Body **10** may be formed from any manufacturing process known in the art, such as hand-laying, bladder molding, pultrusion, insert molding, and the like. Reinforcement features **20** are preferably formed on body **10** using hard external tooling and an internal bladder into which reinforcement features **20** may be placed at the desired recessed locations in the hard external tool relative to a carbon fiber tube which will form the handle body **10**. The composite tube body may be formed by hand rolling or any other means known in the art. In the preferred embodiment, the entire construction including the reinforcement features **20** is then cured together with an epoxy resin thereby binding the composite body **10** to the reinforcement features **20**. One skilled in the art will understand that the preferred manufacturing method will employ reinforcement features **20** having completely round cross-sections, and the composite material of handle body **10** will be pushed inwardly toward the center to make room for the reinforcement features **20**. Optionally, an additional layer of fiber **10** may be wrapped around reinforcement features **20** prior to curing such that reinforcement features **20** are sandwiched between two layers of composite material upon

completion of the curing process. Reinforcement features **20** may be formed from metal or plastic rods of round, square, triangular or other cross-section, cut to the proper dimensions and embedded within each corner, running along it and defining a protective bead protruding from each corner. Preferably, the reinforcement rods used to form reinforcement features **20** have completely round cross-sections of between 0.25 mm and 3 mm in diameter. Reinforcement features **20** may be formed from aluminum, titanium, steel, or scandium wire stock, or from any other metal, metal alloy or plastic known in the art to have higher impact resistance than the composite body **10**. Alternatively, reinforcement features **20** may be formed of an acceptable plastic material since many plastics have good dent resistance and are lighter then metal. In alternative embodiments, described in further detail below, reinforcement features **20** may be formed by cutting rings or plates of the desired shape from, for example, an extruded metal lacrosse handle sized to fit over the outer dimension of composite body **10**. Although a bladder molding method is described herein, any manufacturing means known in the art capable of forming a secure bond between the composite body **10** and reinforcement features **20** may be used to manufacture the stick according to this or any additional embodiments described herein.

[0045] Various manufacturing methods for the improved lacrosse stick handle according to the present invention are described herein. For example, an embodiment of the invention can be made using the following manufacturing steps:

[0046] 1. Cut metal reinforcing rods, plates, or rings from standard stock and form into desired shape.

[0047] 2. Place metal reinforcing members in locating recesses in the composite molding tool.

[0048] 3. Roll carbon pre-preg tube around mandrel according to lay-up schedule.

[0049] 4. Remove mandrel and insert inflatable bladder into tube, then place carbon tube in molding tool over metal parts.

[0050] 5. Close tooling ensuring location of reinforced metal components, wrap outer layer of pre-preg to secure metal if needed.

[0051] 6. Inflate bladder and place composite molding tool in oven to promote resin curing.

[0052] 7. Remove tooling from oven and demold cured handle blank.

[0053] 8. Polish off resin flash if present and apply desired cosmetics.

[0054] In another embodiment, shown with reference to FIGS. **5-7**, reinforcement features **21** may take the form of rings of various diameters, shapes and thicknesses arranged around the outer diameter of body **10**. Reinforcement features **21** may take the form of rings each having a consistent height along the longitudinal dimension of body **10**, as shown in FIG. **5**. Alternately, as shown in FIGS. **6** and **8**, reinforcement features **21** may have varying heights, as measured in the longitudinal dimension of body **10**, around the radius of body **10**. FIGS. **9** and **10** depict a few of the additional shapes that the reinforcement features may take. As depicted in FIGS. **7**, **9** and **10**, body **10** may be manufactured by a pultrusion process, or by other suitable process to have a round cross section along the segment of body **10** onto which reinforcement features **21** will be placed. Alternatively, as shown in FIGS. **5-6** and **8**, reinforcement features **21** may be manufactured to match the octagonal or other non-circular cross-sectional shape of the outer surface of body **10**. This may be achieved by, for example, using an extrusion process to manufacture a metal lacrosse handle sized to fit over the outer dimension of composite body **10** and having the same inner cross-sectional shape as the outer cross-sectional shape of body **10**. As shown in FIG. **5**, the inner and outer cross-sectional shapes of reinforcement features **21** need not be the same. For example, the inner cross-section of reinforcement features **21** may be octagonal to match the outer dimension of body **10**, while the outer cross-sectional shape of reinforcement features **21** may be round to provide a raised surface for additional protection of the less durable composite material forming body **10**. Raised reinforcement features **21** also provide a tactile grip to areas of the stick to which they are applied to allow a player to more easily determine the location of his or her hand(s) without looking at the stick, based solely on knowledge of where raised reinforcement features **21** are located. Alternately, reinforcement features **21** may be manufactured to be flush with the surface of body **10**. Like in the case of reinforcement features **20**, ringed reinforcement features **21** may be placed along portions of body **10** to increase durability and strength in selected, vulnerable areas of body **10**. Rings may be applied to a composite tube body as described above, either by sliding same over the top of the tube body or by splitting the formed rings and wrapping them around the composite tube body. Thereafter, the body will be cured with resin with the shape of the external tooling whether the surface of reinforcement features **21** is flush or raised proud from the surface.

[0055] Yet another embodiment of the present invention is shown with combined reference to FIGS. **11-14***b*. As shown therein, reinforcement features **22** may be in the form of plates placed strategically on areas of composite body **10** that are vulnerable to cracks or breakage from harsh and/or repeated impacts. FIGS. **13***a*-**13***c* depict various shapes that reinforcement feature **22** may take, although it will be understood that various additional shapes of reinforcement plates affixed to a composite stick body **10** not illustrated herein are nonetheless within the scope of the present invention.

[0056] As shown in FIGS. **14***a* and **14***b*, reinforcement feature **22** may either take the same shape as body **10** when viewed in cross-section such that reinforcement feature is flush with body **10** and the entire stick has a uniform cross-section (FIG. **14***a*), or may have a different shape in cross-section than body **10** (FIG. **14***b*). Alternately, as shown in FIGS. **11-12**, the outer surface of reinforcement feature **22** may be raised above the surface of body **10** to provide an additional level of protection for composite fiber body **10** from impacts. In each case, and as described above, reinforcement feature **22** may be injection molded or cut out of an extruded metal tube that either has the same or a different cross-section as body **10**. Another method for creating the reinforcement plates is to cut, stamp or blank them out from flat sheet stock then form to shape before in-molding on the composite handle. Also as described above, reinforcement feature may be laid onto a composite tube body, additional layers of carbon or other fiber may optionally be laid over reinforcement feature **22**, and the entire handle may be cured with resin to adhere reinforcement feature **22** onto body **10**.

[0057] Yet another embodiment of the improved lacrosse stick handle according to the present invention is shown in FIG. **15**, wherein reinforcement features **24** are shown to take the form of a spiral wrapped around composite body **10**. As described above with reference to FIGS. **2-4**, reinforcement features **24** may also be formed by metal wire laid onto the

surface of the pre-impregnated composite tube. Although not shown, reinforcement features **24** may also take the form of a reference finger, or raised wire or ridge running all or part of the length of body **10**, to afford protection from impact to one or more entire sides of body **10**, or to allow a player to sense the rotational position of his or her stick by feel alone based on his or her knowledge of the location of the reference finger.

[0058] As can be seen, the improved lacrosse stick handle described herein provides improved characteristics over a single-material prior art handle, such as low weight dent resistance, toughness, high stiffness, and geometric flexibility. As is known in the art, flex features can be readily built into an all-composite handle and the improved handle of the disclosure maintains that feature while enhancing the durability shortcomings of prior art composite lacrosse handles. Reinforcement features are placed in selected areas of the composite handle body to both minimize denting common in metal stick to stick impacts while limiting microstructure cracking common in all—composite materials which could eventually lead to catastrophic handle breakage.

[0059] Having now fully set forth the preferred embodiments and certain modifications of the concept underlying the present invention, various other embodiments as well as certain variations and modifications of the embodiments herein shown and described will obviously occur to those skilled in the art upon becoming familiar with said underlying concept. It is to be understood, therefore, that the invention may be practiced otherwise than as specifically set forth in the appended claims.

We claim:

1. A shaft for a game stick, comprising:

a tubular body;

one or more reinforcement features on an outer surface of said tubular body on at least the upper third of said tubular body;

wherein said tubular body is formed of a composite material; and

wherein said one or more reinforcement features are formed of a material with higher impact resistance than said composite material.

2. The shaft according to claim **1**, wherein said one or more reinforcement features extend along at least one half the tubular body.

3. The shaft according to claim **2**, wherein said one or more reinforcement features extend along at least two thirds the tubular body.

4. The shaft according to claim **1**, wherein said one or more reinforcement features is formed of a metal or metal alloy material.

5. The shaft according to claim **1**, wherein said one or more reinforcement features is formed of a plastic material.

6. The shaft according to claim **1**, wherein said one or more reinforcement features is a rib member formed along at least a portion of the length of said tubular body and parallel to said length.

7. The shaft according to claim **1**, wherein said one or more reinforcement features is formed from one or more segments cut from an extruded metal handle.

8. The shaft according to claim **1**, wherein said one or more reinforcement features is formed from a non-circumferential plate member arranged along at least a portion of the length of said tubular body along a longitudinal dimension thereof.

9. A shaft for a game stick, comprising an elongate tubular body having a socket end and a butt end, and a polygonal cross-section therebetween defined by a plurality of planar sections intersecting at a plurality of joints, and at least one reinforcing rod embedded in said elongate tubular body and extending along its length.

10. The shaft for a game stick according to claim **9**, wherein said reinforcing rod extends along at least one third of said tubular body at the socket end.

11. The shaft for a game stick according to claim **9**, wherein said reinforcing rod extends along at least one third of a mid-section of said tubular body.

12. The shaft for a game stick according to claim **9**, further comprising a plurality of reinforcing rods embedded in said elongate tubular body and extending parallely lengthwise there along.

13. The shaft for a game stick according to claim **12**, wherein said plurality of reinforcing rods are each embedded along a embedded along a corresponding one of said plurality of joints.

14. The shaft for a game stick according to claim **12**, wherein said plurality of reinforcing rods are each embedded along a corresponding one of said plurality of planar sections.

15. The shaft for a game stick according to claim **13**, wherein said plurality of joints outnumber said plurality of reinforcing rods.

16. The shaft for a game stick according to claim **9**, wherein said elongate tubular body comprises a first material having a known density and impact resistance, and said plurality of reinforcing rods comprise a second material having a higher density and impact resistance than said first material.

17. The shaft for a game stick according to claim **13**, wherein said plurality of reinforcing rods comprise metal rods.

18. The shaft for a game stick according to claim **13**, wherein said plurality of reinforcing rods comprise composite rods.

19. The shaft for a game stick according to claim **18**, wherein each of said plurality of reinforcing rods is embedded along one of said joints but is exposed to define a protective bead projecting from each said joint.

20. The shaft for a game stick according to claim **9**, wherein said at least one reinforcing rod is spiral-wrapped along the length of said tubular body.

21. The shaft for a game stick according to claim **9**, wherein said at least one reinforcing rod has a round cross-section within a range of between 0.25 mm and 3 mm in diameter.

22. A shaft for a game stick, comprising an elongate tubular body having a socket end and a butt end, and at least one reinforcing plate embedded in said elongate tubular body and extending along its length.

23. The shaft for a game stick according to claim **22**, wherein said reinforcing plate is a ring that encircles said tubular body.

24. The shaft for a game stick according to claim **23**, further comprising a plurality of reinforcing rings.

25. The shaft for a game stick according to claim **24**, wherein said elongate tubular body comprise a first material having a known density and impact resistance, and said plurality of reinforcing rings comprise a second material having a higher density and impact resistance than said first material.

26. The shaft for a game stick according to claim **25**, wherein said plurality of reinforcing rings comprise metal rings.

27. The shaft for a game stick according to claim **26**, wherein said plurality of reinforcing rings comprise composite rings.

28. A shaft for a game stick, comprising an elongate tubular body having a socket end and a butt end, and a polygonal cross-section therebetween defined by a plurality of planar sections intersecting at a plurality of joints, and at least one reinforcing plate embedded in said elongate tubular body and extending lengthwise along one of said planar sections.

29. The shaft for a game stick according to claim **28**, wherein said reinforcing plate extends along at least one third of said tubular body at the socket end.

30. The shaft for a game stick according to claim **28**, wherein said reinforcing plate extends along at least one third of a mid-section of said tubular body.

31. The shaft for a game stick according to claim **28**, further comprising a plurality of reinforcing plates embedded in said plurality of planar sections.

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