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(54) **ULTRA-LOW MASS COMPOSITE PERSONAL DEFENSE BATON**

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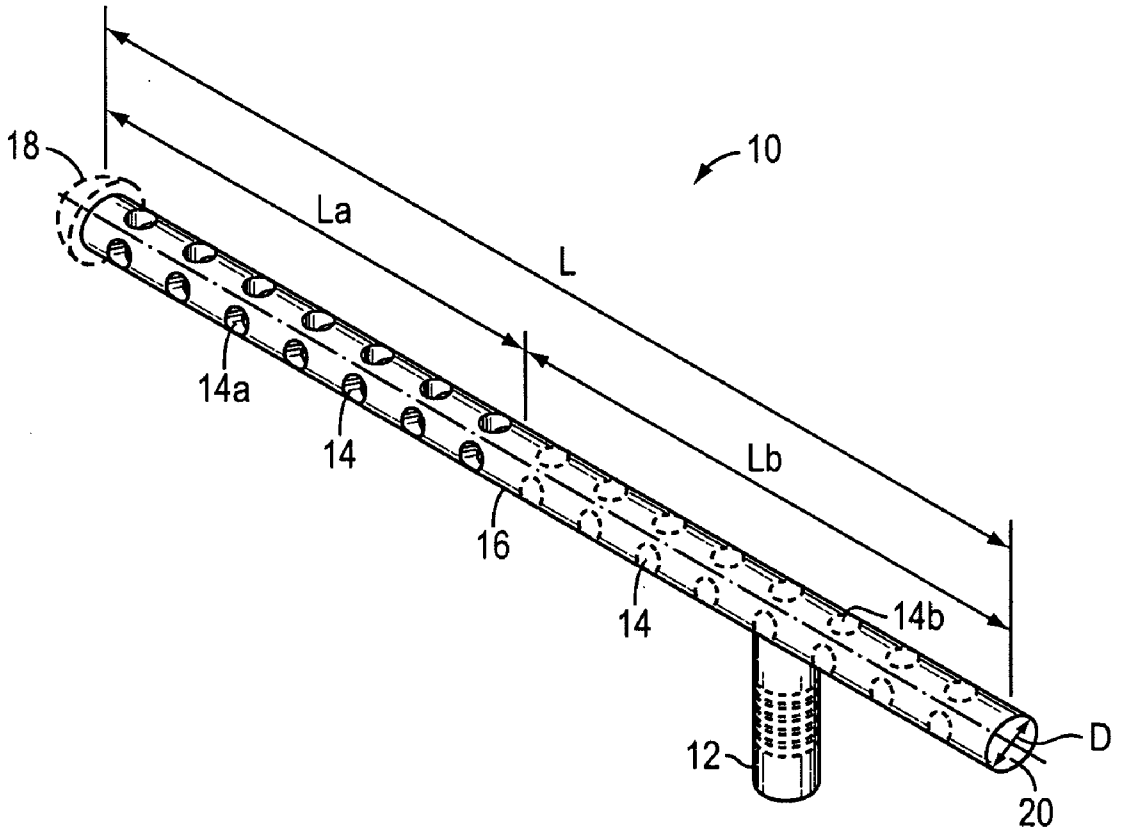
(52) **U.S. Cl.** **463/47.2**

(57) **ABSTRACT**

A hollow, perforated, high-strength composite personal defense baton for personal protection has ultra-low mass for reduced likelihood and/or severity of blunt trauma injury. The baton may be held and wielded at any point along the body or shaft of the baton. Due to the low mass and perforations, one or two of the batons can be wielded with high speed and maneuverability. The high-strength, low-weight composite material offers high flexural strength, reducing blunt trauma injury compared to rigid metal, resin, and wood batons. The composite material is highly resistant to cutting, fracture, and shattering, even under extreme environmental conditions including high levels of UV exposure. The composite material is non-conductive offering collateral use with stun devices.



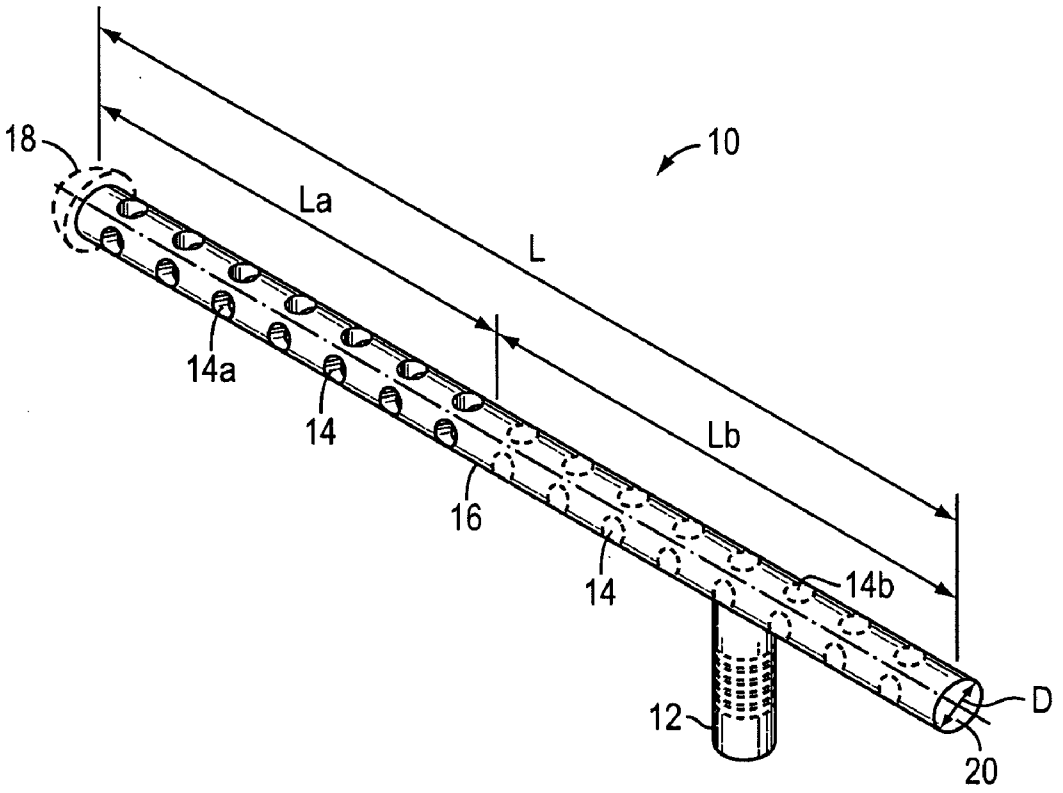


FIG. 1

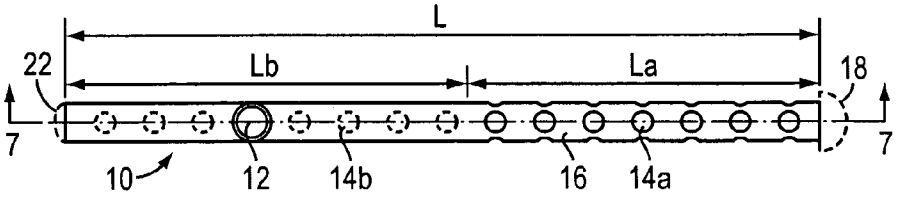


FIG. 2

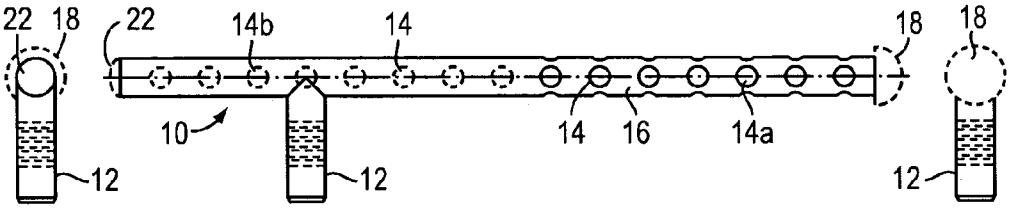


FIG. 3

FIG. 4

FIG. 5

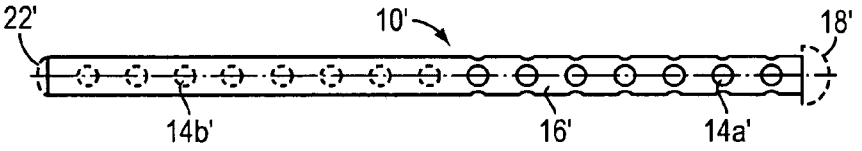


FIG. 6

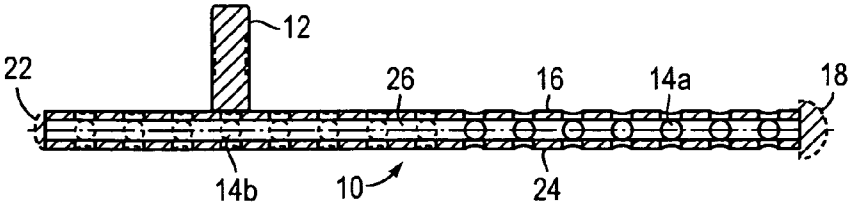


FIG. 7

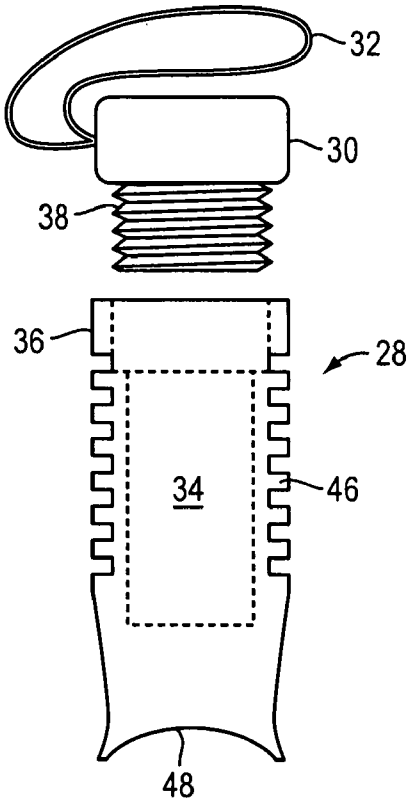


FIG. 8A

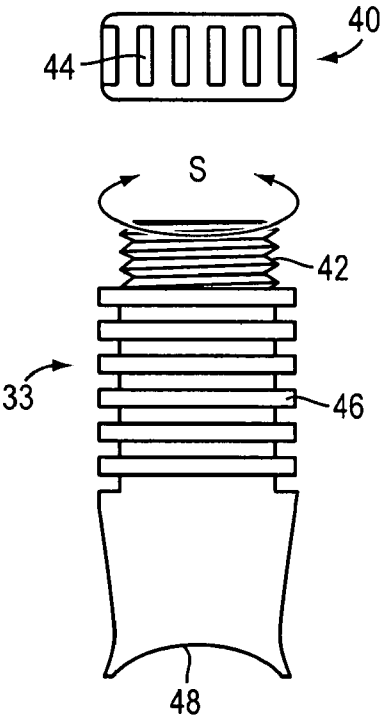


FIG. 8B

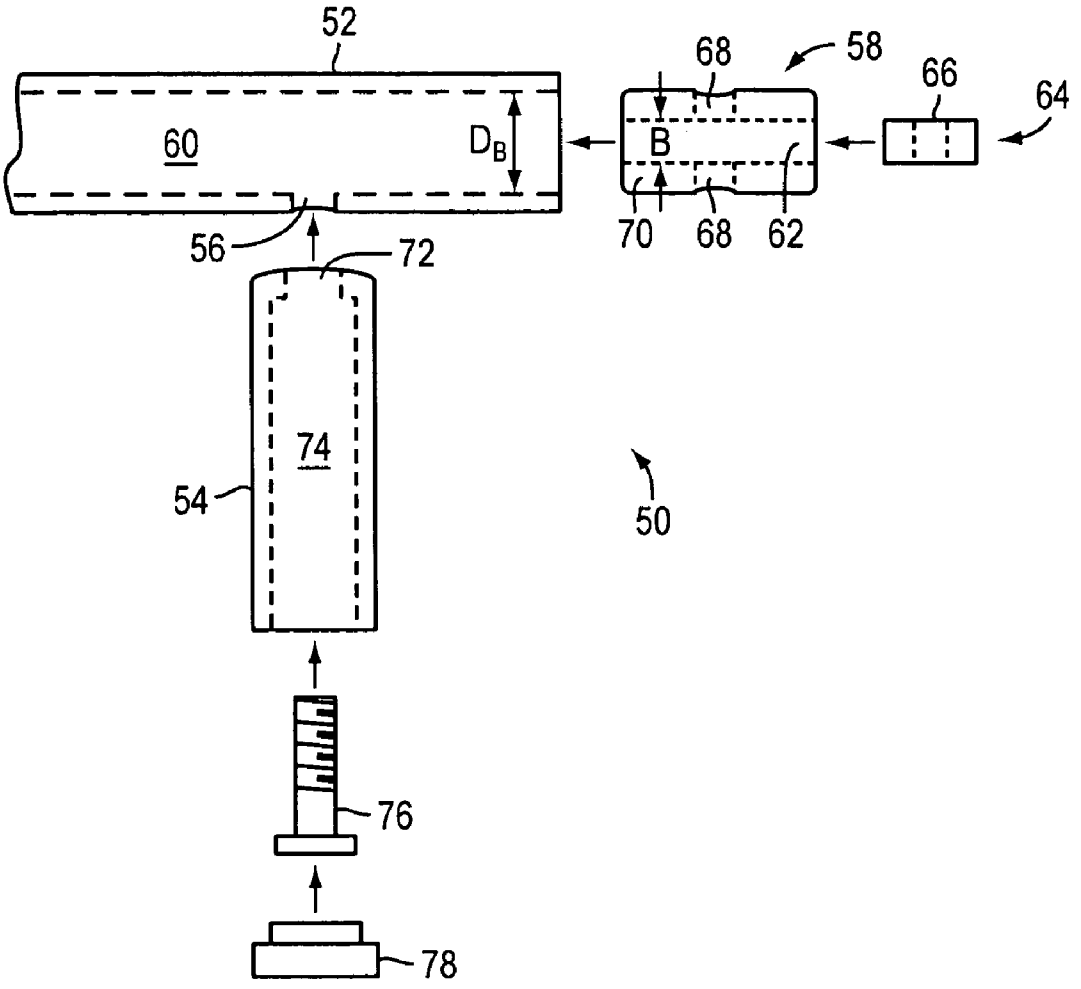


FIG. 8C

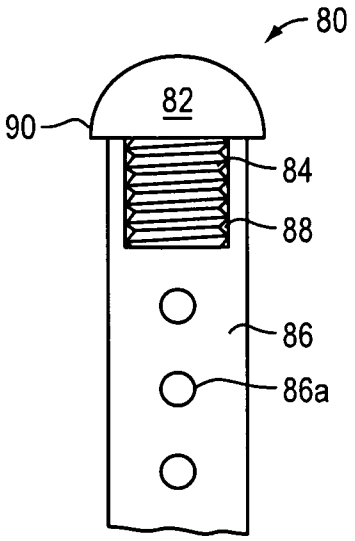


FIG. 9A

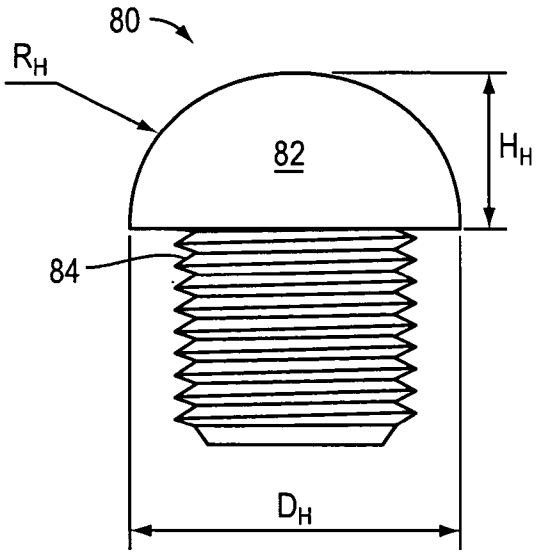


FIG. 9B

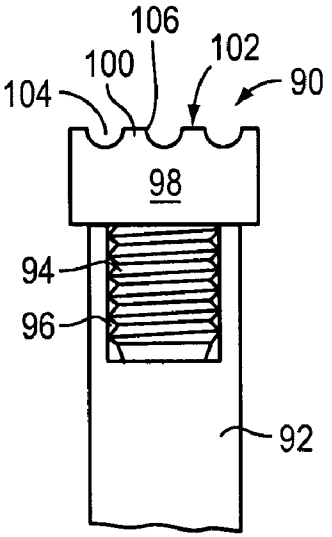


FIG. 10A

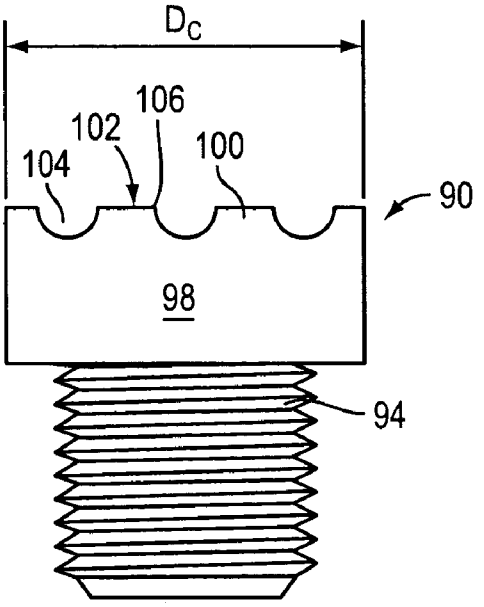


FIG.10B

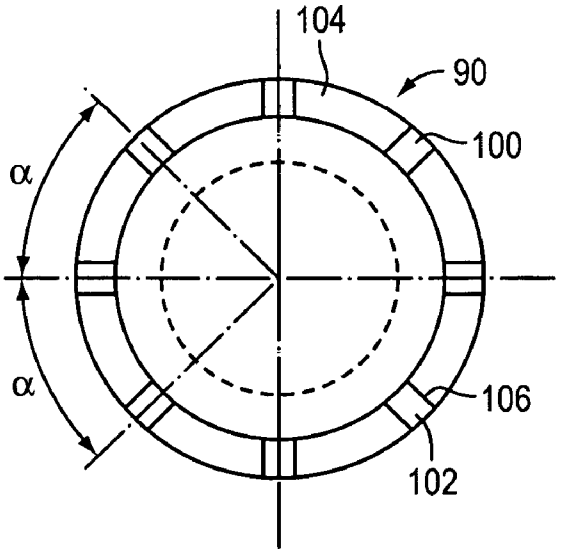


FIG.10C

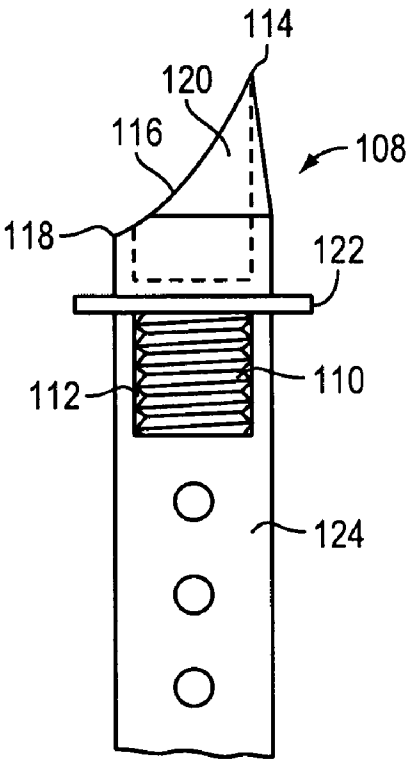


FIG.11A

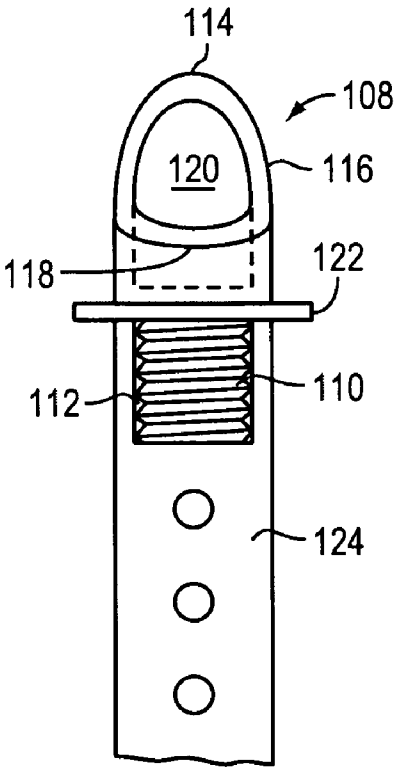


FIG. 11B

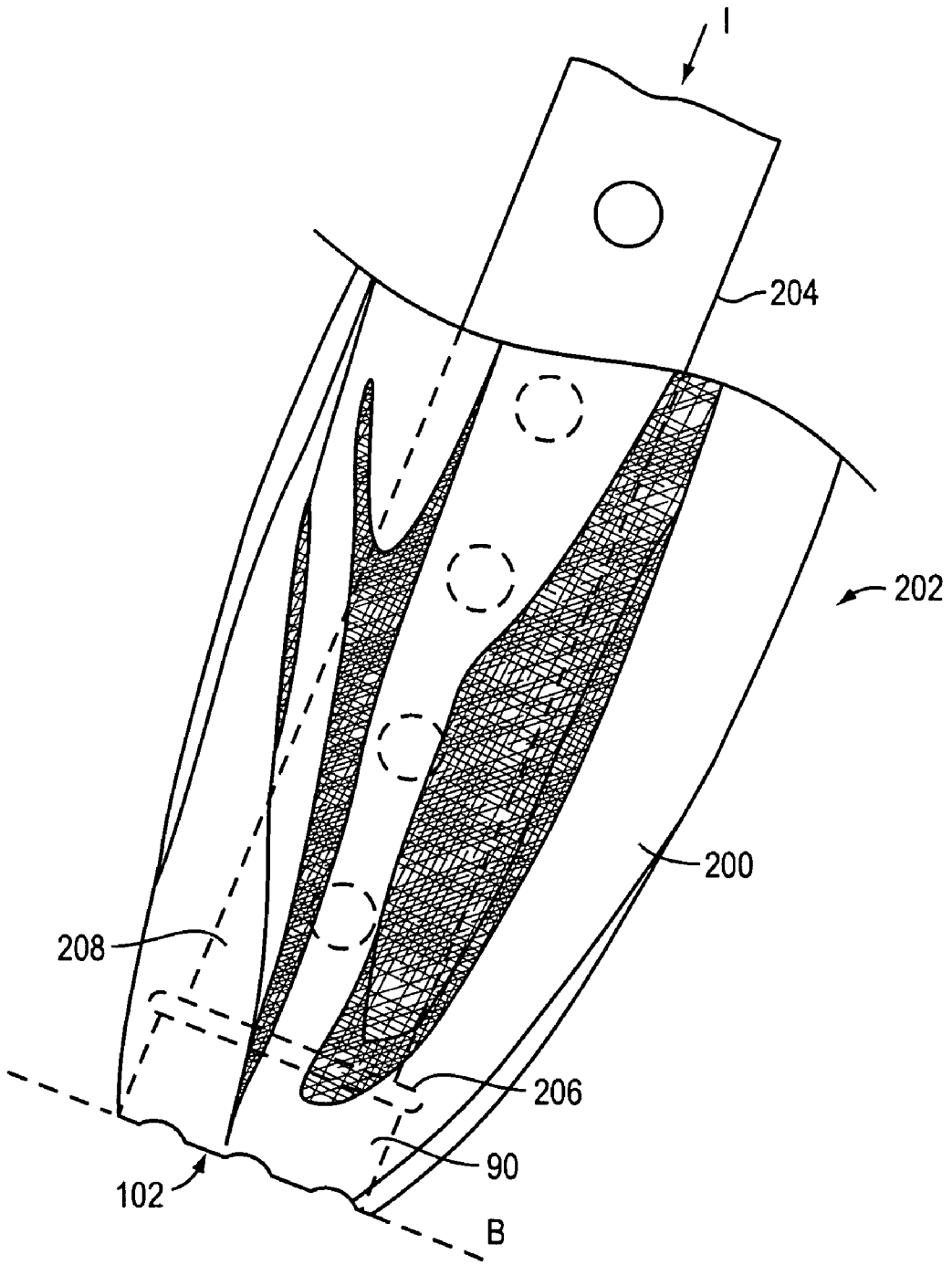


FIG.12A

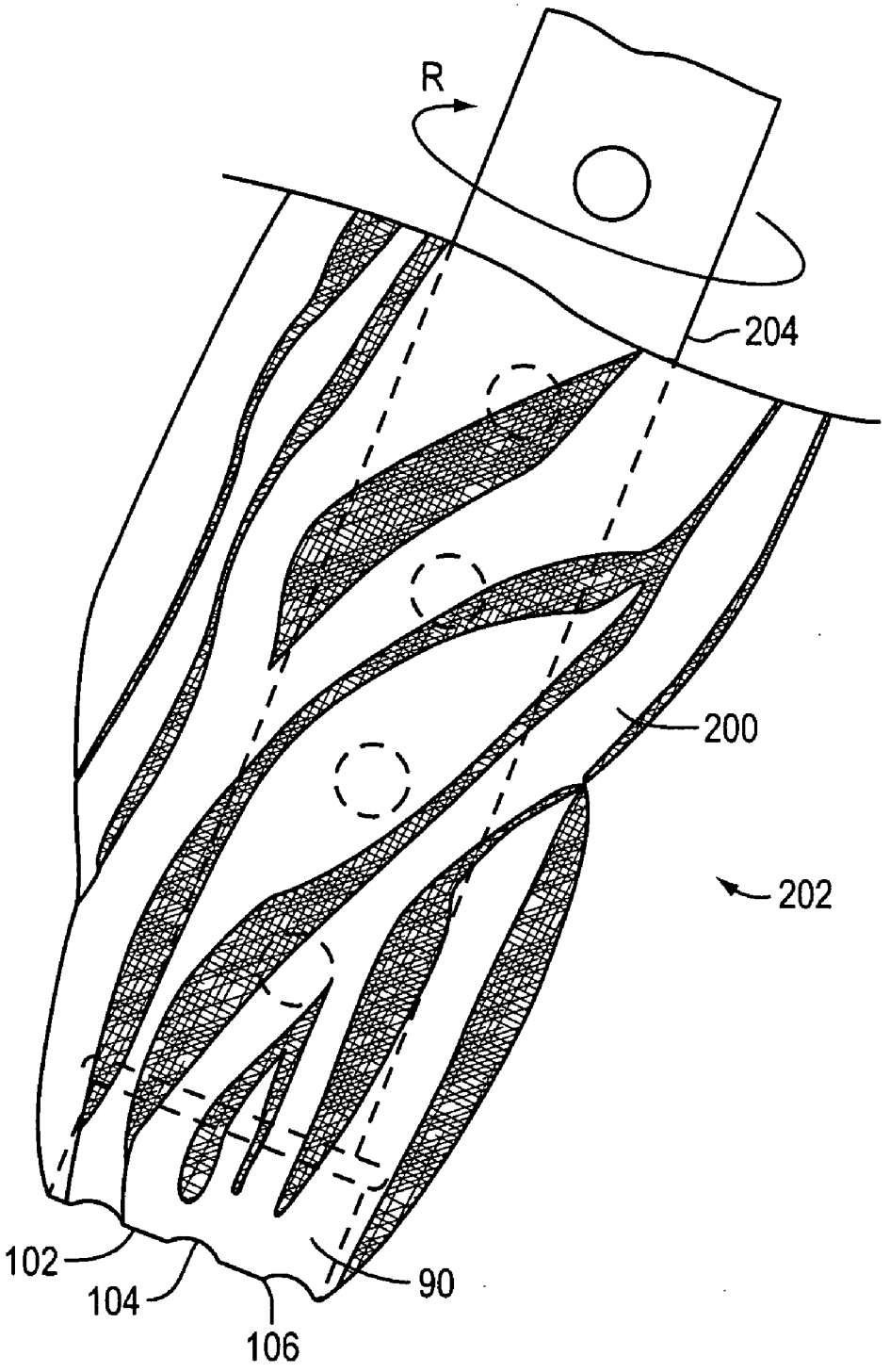


FIG.12B

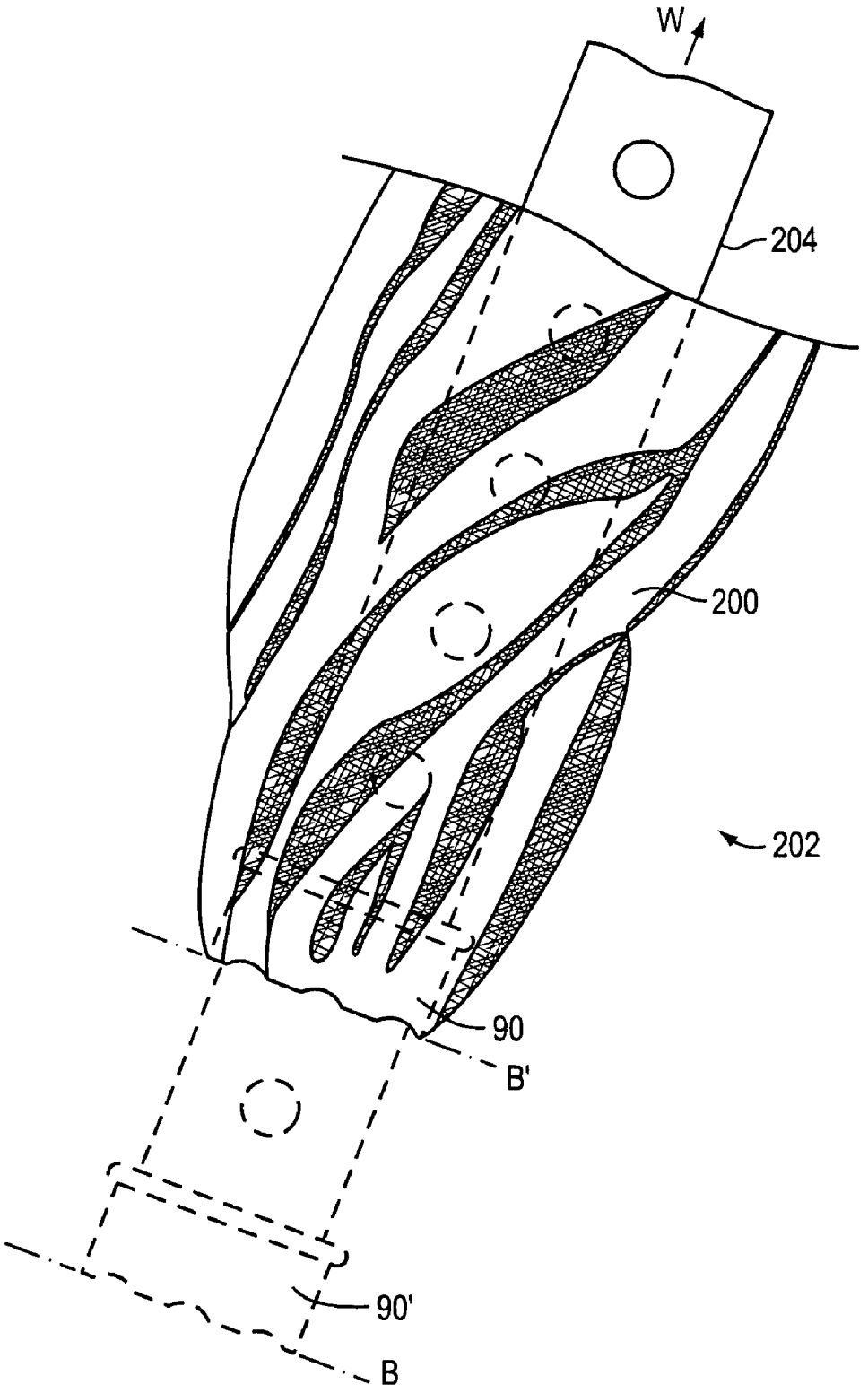


FIG.12C

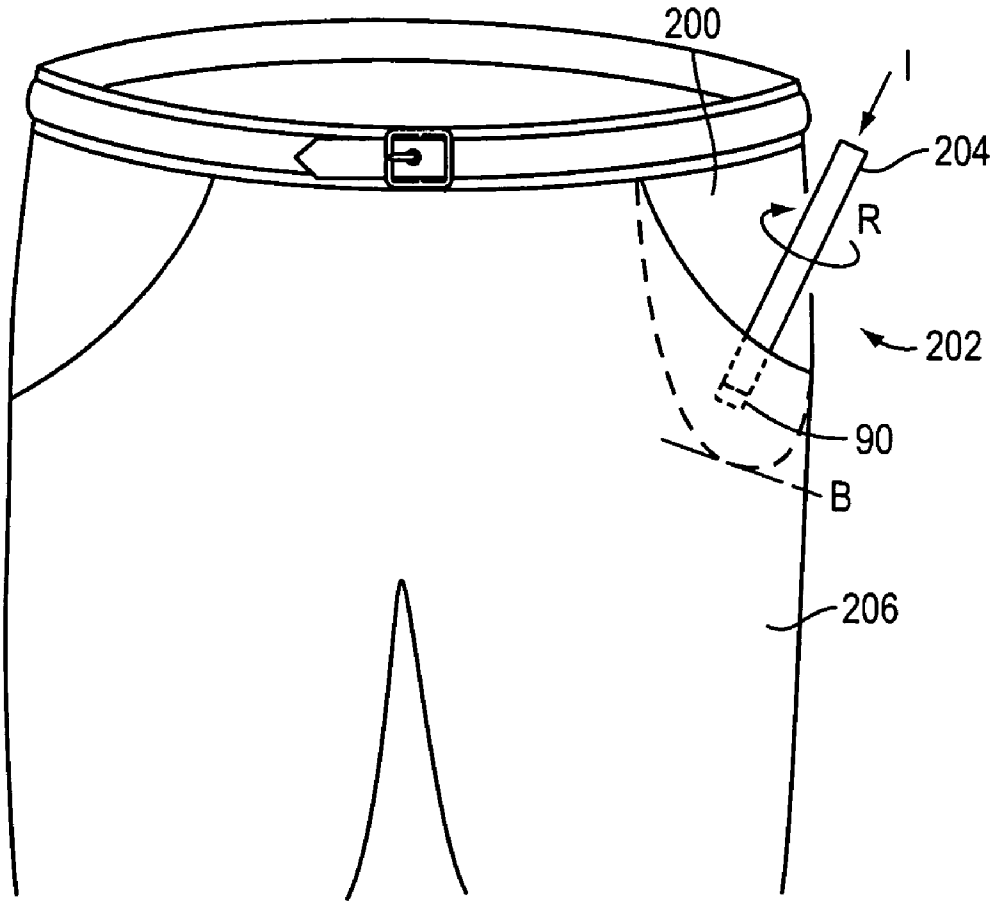


FIG.12D

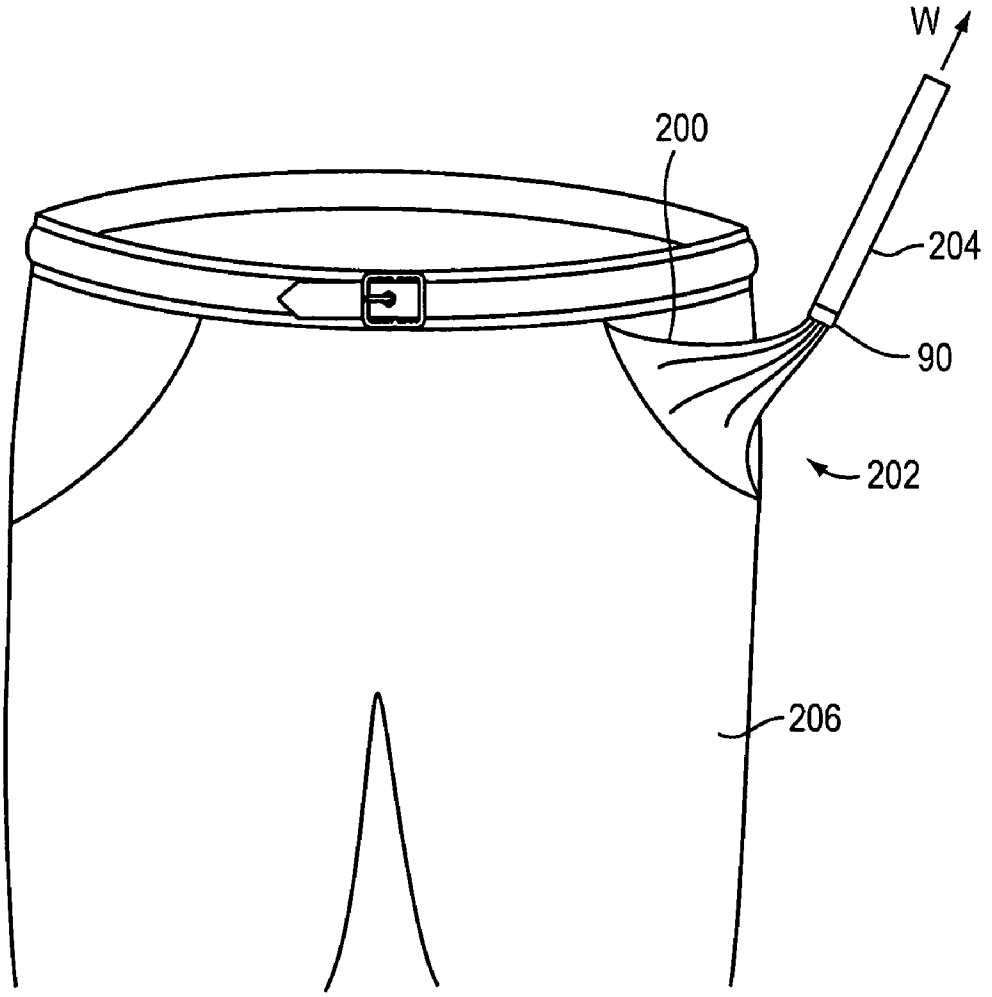


FIG.12E

ULTRA-LOW MASS COMPOSITE PERSONAL DEFENSE BATON

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application incorporates by reference herein in its entirety and claims priority to U.S. Provisional Application Ser. No. 60/729,812, filed Oct. 24, 2005. This application incorporates by reference herein in its entirety and is related to U.S. Design patent application Ser. No. 29/241,158, filed Oct. 24, 2005.

FIELD OF INVENTION

[0002] The invention relates to a high strength, ultra-low weight baton that can be used by individuals, law enforcement, corrections officers and the military, for offensive and defensive tactics typical for a baton, but while offering reduced chance of blunt trauma injury as well as increased speed, simplicity and maneuverability to the user.

BACKGROUND OF THE INVENTION

[0003] Police batons, billy clubs, and/or nightsticks have been used by law enforcement officers since the late 1800's, are versatile, and represent a formidable force in controlling individuals and/or crowds. Evolution of the form and function of the baton has created a variety of more recent devices ranging from expandable batons to batons with multiple functions including lights, lasers, pepper spray dispersion devices and other features, to batons of differing material compositions. In an effort to reduce injury or death from blunt trauma and in view of the importance of emphasizing non-lethal force modalities in law enforcement, different techniques of use also have been developed in an attempt to deploy batons in non- or less-injurious manners. While there are many tactical uses of batons that do not involve striking a subject, the impact pressure of metal and dense resins can easily translate to serious injury to sensitive organs, the head, and bone structures. In cases where strikes are intentionally directed at locations on the body of a victim, a metal or dense resin baton can quickly inflict very serious injury and death if excessive force is used.

[0004] The materials used in manufacture of batons have also changed considerably. Often, batons have generally become heavier and are often made of metal and dense resins and plastics. While these materials may be more versatile and more resistant to moisture and other environmental damage (especially compared to wood batons), these materials may also inadvertently cause more injury to a subject, due in part to their increased mass and rigidity. Additionally, the increased weight of newer batons must be borne by law enforcement, military, or security personnel, who are already burdened by a wide range of duty items that must be carried at all times. Also, heavier batons are more difficult to wield, especially during prolonged encounters with combative subjects; user fatigue increases and may lead to even greater injury to a subject, as the user loses control of the baton due to exhaustion. Heavy batons are also generally deployed less quickly, due in large part to their weight; this decrease in deployment speed may leave a user at a distinct disadvantage in a confrontational situation. A typical prior art baton has a length of 24 inches (61 cm) and a 1¼ inch (3.2 cm) diameter along its length. The baton is manufactured of solid polycarbonate and weighs approximately 20 ounces (567.0 grams), and does not include a handle; its mass-to-length ratio is approximately 9.3 g/cm.

SUMMARY OF THE INVENTION

[0005] There remains a need for a light weight baton that is easy to carry and deploy, that also provides sufficient deterrence to recalcitrant targets, while minimizing the likelihood of excessive blunt trauma.

[0006] In one aspect, the invention relates to a personal defense baton having an elongate shaft defining a void disposed longitudinally therein, the shaft further defining at least one hole through a sidewall thereof. In certain embodiments of the above aspect, the baton includes a handle extending from the shaft. Other embodiments include a bolt, wherein the bolt secures the handle to the shaft, through the at least one hole. In other embodiments, the shaft defines a plurality of holes through the sidewall. In certain embodiments, the holes are arranged symmetrically along a length of the shaft, and/or along a circumference of the shaft. In still other embodiments of the above aspect, the baton also includes an enlarged butt end, which may be scalloped. In yet another embodiment, the shaft includes a polyester graphite composite material having a mass-to-length ratio of less than about 6.0 grams/centimeter.

[0007] In another aspect, the invention relates to a personal defense baton having a one-piece, non-mechanical hollow tube adapted to limit blunt trauma injury to a target individual when struck therewith. In certain embodiments, the hollow tube further defines a plurality of perforations through a sidewall thereof. In some embodiments, the perforations are arranged along the length of the tube. In still another embodiment, the hollow tube includes a high strength composite material of sufficient strength to preclude use of metal structural supporting elements. In other embodiments, the hollow tube includes a polyester graphite composite material having a mass-to-length ratio of less than about 6.0 grams/centimeter.

[0008] In yet another aspect, the invention relates to a personal defense baton having comprising an elongate shaft having a sidewall defining a longitudinal void therein, the sidewall further defining a plurality of apertures therethrough, wherein the apertures are in communication with the void, a longitudinal axis, and a polyester graphite composite having a mass-to-length ratio of less than about 6.0 g/cm, a first butt end at a first end of the shaft, a second butt end at a second end of the shaft, a handle located intermediate the first butt end and the second butt end, the handle projecting from the shaft at an angle substantially perpendicular to the longitudinal axis, and means for securing the handle to the shaft via at least one of the apertures.

[0009] Other aspects and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, illustrating the principles of the invention by way of example only.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The foregoing and other objects, features, and advantages of the present invention, as well as the invention itself, will be more fully understood from the following

description of various embodiments, when read together with the accompanying drawings, in which:

[0011] FIG. **1** is a perspective view of the baton in accordance with one embodiment of the present invention;

[0012] FIG. **2** is a bottom plan view of the baton depicted in FIG. **1**;

[0013] FIG. **3** is a first end elevational view of the baton depicted in FIG. **1**;

[0014] FIG. **4** is a side elevational view of the baton depicted in FIG. **1**;

[0015] FIG. **5** is a second end elevational view of the baton depicted in FIG. **1**;

[0016] FIG. **6** is a top plan view of the baton depicted in FIG. **1**, and alternatively and additionally, is a top/bottom/side view of a baton in accordance with another embodiment of the present invention that does not include a handle;

[0017] FIG. **7** is a cross-sectional view of the baton depicted in FIG. **1**, taken along line **7-7**;

[0018] FIGS. **8**A and **8**B are side views of two embodiments of baton handles in accordance with the present invention;

[0019] FIG. **8**C is a schematic view of a handle attachment system for a baton in accordance with one embodiment of the present invention;

[0020] FIGS. **9**A and **9**B are side views of two embodiments of butt ends in accordance with the present invention;

[0021] FIGS. **10**A, **10**B, and **10**C are side and top views of other embodiments of butt ends in accordance with the present invention;

[0022] FIGS. **11**A and **11**B are side and top views of other embodiments of butt ends in accordance with the present invention; and

[0023] FIGS. **12**A-**12**E are schematic views of a pocket turn-out method in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0024] In one embodiment, the baton is single piece, non-mechanical, hollow, and perforated. The invention disclosed herein can be deployed and configured in a variety of different forms. Shown in the drawings and described herein below in detail are various embodiments of the invention. It is to be understood that the present disclosure is an exemplification of the principles of the invention and does not limit the invention to the illustrated embodiments.

[0025] Referring to the drawings, FIGS. **1-6**, show various views of a baton **10** with an attached handle **12**, and having perforations, holes, or apertures **14***a*, **14***b* formed along the length of the shaft **16**. The handle **12** may be integrally molded with the shaft **16**, chemically bonded to the shaft **16**, detachable with a simple twisting motion (e.g., a bayonet retention style fitting), or can be attached mechanically, for example by a set screw, as depicted in FIG. **8**C. The handle also can be affixed with a threaded connection or secured to a matching ring. The ring, in turn, may be set in a circular groove around the outer circumference of the shaft, allowing free rotation of the handle around the baton shaft **16**. The perforations, holes, or apertures **14** may be larger or smaller, depending on and/or in proportion to the shaft diameter D and length L. The apertures may also be limited to either end of the shaft **16**. The depicted embodiment shows apertures **14***a* arranged symmetrically along about one-half of the shaft length L_A, but additional apertures **14***b* may be present along the remaining length L_B of the shaft **16**, as depicted by the dashed lines. Other embodiments of the baton include no apertures, thus making the baton appear similar to prior art solid batons, but with the advantage of decreased mass, as the shaft is still hollow. Still other embodiments may utilize apertures arranged non-symmetrically or randomly along the length of the shaft. In addition to decreasing wind resistance during deployment and reducing weight of the baton **10**, the perforations **14** provide a textured surface, allowing the baton **10** to be grasped securely anywhere along its length L, an advantage over smooth batons that may become slippery due to weather and usage. The end opposite the handle **12** may also be alternately equipped with an end cap **18** of any type, which may be either slipped over the end of the shaft **16** or threaded in unison with internal or external threads in the interior of the shaft **16**, or chemically bonded to the shaft **16**, thus allowing a secure union. The end cap may comprise virtually any geometry and be made from any material, and may be hollow and of similar composition as the baton shaft. One particular embodiment is shown in FIGS. **1-6** in dashed lines; other embodiments are depicted in FIGS. **9**A-**11**B. The butt end of the baton **10** nearest the handle **12**, identified as **20**, may be uncapped, as shown, or may also be fitted with any type of end cap (e.g., a small butt-end cap **22** is depicted in FIGS. **2-6**).

[0026] In addition to depicting the top view of the baton **10** of FIG. **1**, FIG. **6** also depicts a top/bottom/side view of a baton **10'** manufactured without a handle. In certain embodiments, this configuration may be made in lengths up to and beyond 48 inches, offering a riot baton of ultra-light weight. The apertures **14***a'*, **14***b'* along the length of the shaft **16'** provide for secure gripping, as described above. Similarly, the butt ends **18'**, **22'** utilized on the embodiment having a handle may be utilized with this embodiment.

[0027] FIG. **7** shows a longitudinal transverse section illustrating internal construction features of the baton **10** or **10'** (though the handle **12** is not present on baton **10'**). The baton **10** is hollow along the entire length of the shaft **16** and the apertures **14***a*, **14***b* pass entirely through the shaft sidewall **24**, intersecting the void **26** within the shaft **16**. Alternatively, the sidewall of the shaft may only define a void extending partially along the length of the shaft **16**. In such an embodiment, the apertures may or may not intersect the void. By varying the length and diameter of the void **26**, the weight of the baton **10** may be adjusted as desired. This embodiment depicts the handle **12** integral with the shaft **16**. In such an embodiment, the handle **12** may be chemically set to the shaft **16** after both components are manufactured, or the entire handle/shaft assembly may be integrally molded with apertures, if desired, machined through the shaft **16** during the final stages of manufacture.

[0028] FIGS. **8**A and **8**B show two embodiments of the handle utilized with the present invention. As depicted in FIG. **8**A the handle **28** may be hollow and utilize a screw-on end cap **30**. The end cap **30** may include a lanyard **32** threaded though or otherwise secured to the cap **30**. The

hollow portion **34** of the handle **28** may be utilized as a container for small outdoor survival items, such as matches and the like, making the device particularly useful in military applications. Similarly or additionally, law enforcement officers may benefit by using the hollow handle portion **34** to store a spare set of handcuff or vehicle keys. The hollow section **34** may also allow for a point of concealment for the connecting set screw utilized in certain embodiments, for example, as depicted in FIG. **8**C. The hollow section may also be sized to contain one or more spare butt caps, which may be switched in the field by the user, as desired for a particular application. The mating portion **36** may be sized slightly smaller than rubberized washers **30***a*, to form a friction fit connection, if the end cap **30** is of a press-fit configuration, as depicted in FIG. **8**A.

[**0029**] FIG. **8**B depicts another handle **38**, including a cap **40** that is screwed on to matching male threads **42** on the handle **38**. Alternatively, the cap may include male threads that match female threads present on the handle. The cap **40** may be knurled or otherwise textured **44** to form a surface for gripping while the cap is screwed S onto or off of the handle **38**. Either depicted handle **28**, **38** may be made of any material suitable for the shaft, and may include any type of texture, knurling, grooves, etc., **46** to provide a secure grip during use. The end caps depicted in FIGS. **8**A and **8**B may also be shaped of suitable material or materials, be geometrically shaped, or otherwise manufactured. The handles **28**, **38** may also include a curvature **48** complementary to that of the outer curvature of the shaft. The complementary curvature **48** allows for secure attachment to the shaft, without the risk of loosening due to an improper fit.

[**0030**] FIG. **8**C depicts an handle attachment system **50** for a baton that allows for secure connection between a shaft **52** and a handle **54**. In this embodiment of the system **50**, the shaft **52** includes a single aperture or perforation **56** for securing the handle **54**. Alternatively, the system may be utilized on a partially or fully perforated shaft, for example, as depicted in FIGS. **1**-**6**. Additionally, the system **50** allows the handle **54** to be detached from the shaft **52**, so the shaft **52** may be utilized without the handle **54**, if desired. Thereafter, the handle **54** may be reattached; in the case of the fully or partially perforated shaft, the handle **54** may also be attached utilizing any perforation on the shaft **54**, not just the aperture **56** to which the handle **54** was originally attached.

[**0031**] In the depicted embodiment, the system **50** includes a slug **58** having an outer diameter substantially complementary to the internal diameter D_B of the void **60** within the shaft **52**. The slug **58** may be press fit into the void **60**. The slug itself is hollow, having a void **62** with an internal diameter D_S substantially complimentary to the outer diameter of a threaded nut **64**, which is press fit into the slug **58**, such that a threaded connection **66** aligns with through-holes **68** though the outer wall **70** of the slug **58**. The slug **58** (containing nut **64**) is inserted into the hollow shaft **52**, such that through holes **68** are aligned with aperture **56**. An aperture **72**, communicating with the hollow section **74** of the handle **54**, is then aligned with the aperture **56**, thus allowing a bolt **76** to be secured tightly to the threaded connection **66**. End cap **78** is then screwed or otherwise secured onto the handle **54**.

[**0032**] FIGS. **9**A and **9**B show a butt end cap configuration for the baton of the present invention. The end cap **80** defines a generally hemispherical shape **82**, and utilizes a threaded connection **84** to be secured to the end of the shaft **86** having apertures **86***a*. Other shapes contemplated include cubic pyramidal, prismatic, spherical, etc. Additionally, the end may be integrally molded with the shaft of the baton, secured utilizing a recessed screw or bolt or chemically bonded, or may use a threaded connection **84** as depicted, to mate with a matching threaded connection **88** at the end of the shaft **86**. The end cap **80** may also define a hollow void to reduce weight and subsequent momentum of the end of the device during use. Further embodiments that may help reduce blunt force trauma include end caps made of a resilient or semi-resilient material, which may be utilized for training purposes or when further reduction of potential injury is desired. The edge **90** of the hemispherical shape **82** may meet the outer diameter of the shaft **86** (i.e., the diameter D_H of the hemispherical surface **82** may be the same as the outer diameter of the shaft **86**). The radius of curvature R_H may be constant or varied (i.e., a constant radius would correspond to the hemispherical shape **82** depicted. Variations in the radius R_H may be used to adjust the total height H_H of the end cap **80**.

[**0033**] FIGS. **10**A-**10**C show an scalloped end cap **90** configuration for the baton made of the same light weight material as the baton shaft **92**. The scalloped end cap **90** utilizes a threaded connection **94** to be secured to the end of the shaft **92**. The end cap **90** may also be integrally molded with the shaft of the baton, secured with a recessed screw or bolt or chemically bonded, or may use the threaded connection **94**, as depicted, to mate with a matching threaded connection **96** at the end of the shaft **92**. The end cap head **98** may include one or more raised surfaces or crenellations **100**. Each crenellation **100** generally includes a raised surface **102**, and is separated from adjacent crenellations by a curved or grooved valley **104**. The edge surfaces **106** may be slightly rounded or may be sharp corners. A symmetrical plurality of crenellations **100** may be located around the outer circumference of the head **98**. The depicted embodiment includes eight crenellations **100** at 45 degrees separation. The angle α between crenellations may vary depending on the particular application or other considerations, and the number of crenellations may also vary. The diameter D_C may be larger than the outside diameter of the shaft **92**, as depicted, or may coterminous therewith. Additionally, the area of each raised surface **102** may vary, as may the curvature of each valley **104**. In addition to being a more aggressive end cap than the hemispherical end of FIGS. **9**A and **9**B, this particular shape provides an individual additional tactical option of using the baton to explore and turn out pockets of an individual once the individual is subdued, as depicted in FIGS. **12**A-**12**C.

[**0034**] FIGS. **11**A and **11**B depict a tapered end cap **108** configuration for the baton, made of the same lightweight material as shaft **110**. The tapered end cap **108** utilizes a threaded connection **110** to be secured to the end of the shaft **124**. The end cap **108** may also be integrally molded with the shaft **124** of the baton, secured with a recessed screw or bolt or chemically bonded, or may use the threaded connection **110**, as depicted, to mate with a matching threaded connection **112** at the end, of the shaft **124**. The end cap **108** may include a leading point or curved edge **114**. The outer edges **116** projecting from the base edge **118** may slightly curved (as depicted) in one or multiple dimensions, or may extend straight from the base edge **118**. The end cap **108** may

include a partial void **120**. While the end cap **108** may be made from the shaft material, an alternative embodiment may be manufactured with stainless steel or other metal. In such a case, one or more of the edges **114**, **116**, **118** may be sharpened, so the tapered end cap **108** may be used as a slashing, puncturing, and/or coring implement. Such a cap may potentially increase the lethality of the baton; thus, an optional collar or basket **122** may be included at the base of the cap **108** to limit depth of penetration of the tapered end **108** into a target.

[**0035**] As depicted in FIGS. **12**A-**12**C, the scalloped end cap **90** allows insertion into a pocket **200** of a coat or trousers or any pocket-like feature of clothing and, with a quick twist, the pocket liner can be engaged and pulled out for inspection. In the depicted method **202**, a baton **204** including a scalloped end cap **90** is inserted I into the pocket **200**. In the depicted method **202**, a rubberized washer or ring **206** is secured between the end cap **90** and shaft **208** of the baton **204**. This ring **206** is not required, but if used, it may extend beyond the outer diameter of the end cap **90** and, due to a higher coefficient of friction, provide a better grip against the fabric of the pocket **200**. Alternatively, the end cap may itself be rubberized, or include a rubberized sheath or coating. The baton end cap **90** is inserted I into the pocket **200**, until the raised surfaces **102** contact the base B of the pocket **200**, pushing the pocket material downward.

[**0036**] As depicted in FIG. **12**B, the baton **204** is rotated R (in this case, approximately **90** degrees), causing the pocket fabric to twist and tighten around the end cap **90**. Particularly, the edge surfaces **106** catch the pocket **200** material, gripping the fabric, as the material bunches slightly into grooves **104**. So held, as the baton **128** is withdrawn W from the pocket **200** (as depicted in FIG. **12**C), it pulls the pocket **200** material up from the first base position B to a second, higher base position B', the initial position of the end cap **90'** is depicted in phantom in FIG. **12**C. As the baton **204** is further withdrawn W, eventually the scalloped end cap **90** pulls the pocket material inside out from the pocket **200**, allowing for visual inspection of the contents.

[**0037**] FIGS. **12**D and **12**E depict the method being used on a pocket **200** of a pair of pants **206** of a subject. Again, the baton **204** is inserted I into the pocket **200**, until the end cap **90** contacts the base B of the pocket **200**. Once the base B is contacted, the baton **204** is rotated R, catching and twisting the pocket material. As depicted in FIG. **12**E, the baton **204** is then withdrawn W, thereby pulling the pocket **200** out of the pants **206**, with the end cap **90**. In addition to this very specialized use, the baton described herein can be handled in the same manner as for any traditional baton including methods of gripping, carrying on a belt, high and low blocks with one or both hands, jabbing in any number of positions and maneuvers typical of baton movement. The ultra-low mass and particular construction details of the baton increases performance speed of these movements.

[**0038**] The baton may be manufactured, for example, by injection molding, either under a vacuum or otherwise. All or a fewer number of the apertures may be formed during the injection molding process. Alternatively, the shaft itself may be formed via molding, casting, or other known methods, including wrapping a resin impregnated material around a mandrel or other form. The apertures may be subsequently machined through the hollow tube as required. In this manner, a number of batons of various length may be manufactured from a single, long sample of tube material, cut at virtually any location along the length of the sample, and machined or drilled as required.

[**0039**] The baton of the present invention is a very low weight and easily maneuverable baton that greatly reduces intentional and unintentional injury while providing the same effective defensive and offensive benefits of typical heavier batons. The low weight feature of the baton provides an easily carried, stored, concealed and deployed device that is of great strength and durability, being made of a composite material without the need for a metal core or supporting structure. Batons in accordance with the present invention may be constructed in virtually any length; typical lengths for law enforcement would include **16**, **20**, and **24** inches, and may or may not include the handle depicted, for example, in FIGS. **1**-**5**. In the hands of an experienced user, batons of lengths as short as 6 in. or 8 in. may provide numerous offensive and defensive deployment options. Batons as long as or longer than 48 in. provide for effective riot control. Hollow batons with outside diameters of 0.75 in. to 2.0 in. and sidewall thicknesses of 0.125 in. to 0.25 in. are contemplated, though batons of other diameters and sidewall thicknesses that constructed of materials that display similar flexural and other properties are also contemplated. Such batons may be manufactured with or without apertures.

[**0040**] The low mass-to-length ratio allows the baton to be deployed quickly and effectively. In one embodiment, a 16 inch (40.6 centimeter) baton, without handle, has a mass of 4.2 ounces (120 grams). This results in a mass-to-length ratio of approximately 3.0 grams/centimeter, though mass-to-length ratios up to 6.0 g/cm or higher (depending on material used, size of internal void, number and size of apertures, etc.), would allow for faster deployment. In other embodiments, the batons weigh approximately 7.1 oz (200 g) with a diameter of approximately 1 in. (2.5 cm) and a length from 16 in. (40.6 cm) to 24 in. (61 cm). The mass-to-weight ratios for these embodiments are 4.9 g/cm and 3.3 g/cm, respectively. As indicated above, the number and location (around the circumference and along the length) of the apertures, if present, may vary. In one embodiment, 0.5 in. diameter apertures are arranged approximately 1.3 in. on center (as measured longitudinally along the entire length of the shaft); the centers of these apertures are located at 0 and 180 degrees on the circumference of the shaft. At 90 and 270 degrees are other 0.5 in. apertures, again arranged approximately 1.3 in. on center (as measured longitudinally along the entire length of the shaft). The apertures at 90 and 270 degrees, however, are offset from the 0 and 180 degree apertures so as to be at longitudinal locations midway between the 0 and 180 degree apertures.

[**0041**] To achieve the ultra-low weight characteristic of the baton, in one embodiment, the device is made from a tube of polyester graphite composite that is perforated with openings, which may be circular, square, or otherwise. The openings reduce the overall mass of the baton, decrease friction with air as the baton is being deployed, and impart an increased flex in the baton when striking a target. The high flexural strength reduces the rigidity of the baton as it comes into contact with a subject, thereby reducing momentum to the skin and underlying tissues. Materials that have flexural strengths up to approximately 6,000 psi to approxi-

mately 8,000 psi and greater are contemplated. A reduced momentum reduces pressure at the point of impact and potential injury. The material provides an intrinsic force-limiting mechanism as the light weight material effectively limits the transfer of force, irrespective of the velocity used by an individual wielding the device.

EXAMPLE

[0042] To evaluate the differences between hollow tubing that may be utilized in the baton of the present invention, three sample materials were compared to a prior art solid material polycarbonate baton, Model PR24, manufactured by Monadnock Lifetime Products, Inc., of Fitzwilliam, N.H. The PR24 is a 1.28 in. diameter×24 in. solid rod. The three materials tested were Ultracomp UC200, manufactured by TriStar Plastics Corp., of Shrewsbury, Mass. (0.872 in. I.D.×1.125 in. O.D.×24 in.); RT320, manufactured by Norplex-Micarta, of Postville, Iowa (0.874 in. I.D.×1.127 in. O.D.×24 in.); and EX350B, manufactured by Norplex-Micarta (0.874 in. I.D.×1.128 in. O.D.×24 in.). Testing was performed to evaluate the flexural properties of the three sample materials for non-lethal riot sticks and close quarter batons, relative to the PR24 baton. Testing was performed on a Tinnius Olson H50K-S unit, 10,000 psi capacity. Each sample and the baton was individually placed on holding fixtures placed evenly at each end of the test piece. A compression anvil was centered at the 12 in. mark of each sample and compressive force was applied at a rate of 0.5 in. per minute. Extension (deflection) readings in inches and compressive force in pounds per square inch were measured for each. The table below summarizes the results:

Sample	Extension	Load	Comments
PR24	4.36"	978.4 psi	Test stopped - fixture not suitable for full test to failure. 98% recovery upon release of load.
UC200	2.04"	452.6 psi	Tube collapsed at load indicated. Minor recovery.
RT320	1.2"	436 psi	Material snapped in two. Unusually clean break.
EX530B	2.63"	134 psi	Due to elastomer content material collapsed at low pressure. No cracks noted 95% recovery when load released.

[0043] The PR24 baton appeared to display some elastomeric qualities. It is a rigid, yet apparently, non-breakable product within forces capable of creation by a human user. It would likely have had produced different results in a tubular form, such as the other tested samples. The UC200 sample displayed no break in the fibers and no cracking of the resin, even when deflected far beyond the manufacturer's recommended performance point. The material collapsed on itself and had reasonable recovery for a non-elastomer based material. The RT320 sample snapped at 436 psi, but the deflection was only 1.2 inches. There may be advantages to a baton manufactured of this material, provided the breaking force is less than a particular damaging force delivered to a subject during use (for example, if the breaking force is less than a corresponding breaking force of a human bone, debilitating injuries from use of the baton may be lessened or avoided). The EX530B sample had better elastic recovery after deflection, possibly due to the amount of elastomeric additive in the material. That elastomeric additive may also explain the low pressure rating, as the load was absorbed by the baton itself. No rigid feedback was recognized by the test unit, so it continued to deflect at the same psi compressive load. This testing indicates that UC200, RT320 and EX530B tubular materials could be well-suited for use in a riot stick or baton as they are responsive, flexible, and non-breakable under normal baton usage loading conditions, unlike the solid PR24 baton, which likely would produce injury due to its configuration and material performance characteristics. For example, each of the tubular materials collapsed or broke at loads ranging between 14% and 46% of the maximum tested loading of the PR24 baton, which did not fail.

[0044] Material utilized in the manufacture of the disclosed baton may include plastic, polycarbonate, fiberglass, and related resins, as well as polyester graphite that can be mixed with a wide variety of composite materials with desirable strength and other characteristics as herein disclosed. Suitable composite materials also include polyester/PTFE, polyester/MOS2, blended fiber/graphite, high PV polyimides, polybenzamidizole, PTFE filled PBT, PTFE filled acetal, filled PTFE, solid lubricant filled nylon type 6, aramid fiber filled nylon, PBT, oil and MOs filled nylon type 6, heat stabilized nylon, and other materials. Such materials are available from St. Gobain Performance Plastics Corporation, of Aurora, Ohio, under the brand names Meldin and Rulon; Ensinger GmbH of Nufringen, Germany, under the brand names Hydex and Hydlar; TriStar Plastics Corp., of Shrewsbury, Mass., under the brand name Ultracomp; Celanese Acetate, LLC, of Dallas, Tex., under the brand name Celazole; Norplex-Micarta, of Postville, Iowa, under the designators R320 and EX350B; and Solvay Advanced Polymers, LLC, of Alpharetta, Ga., under the brand name Torlon.

[0045] In the depicted embodiments, the baton is non-mechanical, precluding the difficulties of mechanical malfunction found in expandable and telescoping batons, although expandable and telescoping batons could also benefit from the technical details of manufacture disclosed herein. The baton body may be machined from a single piece of tubular composite material with no moving parts. The composite material has excellent mechanical properties with a high resistance to moisture, cutting, fracture, and rust, and is unlikely to be fouled by extreme hot or cold weather conditions. The composite used in certain embodiments is of sufficient structural strength to obviate the need for any metal in the assembly for support or other structural need. The baton can be made with a wide variety of composites that may approximate or exceed the characteristics of the polyester/graphite composite described. One embodiment of the baton is of the same diameter and material density along the baton body with rolled, smoothed ends at top and bottom, thereby decreasing the blunt trauma relative to many batons that, while reduced in diameter at their striking ends, are often much heavier. Prior art expandable batons may include ends bearing a metal ball or filled with some other heavy substance to facilitate a quick-open action or enhance blunt trauma. A heavier striking area at the baton end, such as is found in batons having steel weights, can easily result in severe injury to sensitive parts of the body,

as the pressure to the body is concentrated in a small area and delivered with a very hard object.

[0046] The baton described herein is easily deployed and used with high speed relative to conventional batons of either traditional or more modem varieties. The apertures in the baton reduce the already reduced mass relative to wood, metal and solid resins, and allow for air flow through as the baton is moved through the air quickly. The single piece construction does not require an initial activation step to be opened as for expandable batons, which often attracts attention and defensive measures by an opponent. Due to the high structural strength of the composite utilized in one embodiment, the baton may be smaller than traditional batons also making the baton easily concealed within and under clothing. The reduced weight and footprint of the baton allow it to be easily worn on a typical duty belt with little fatigue or complication.

[0047] The baton is compatible with use of a variety of other non-lethal devices, particularly with stun devices. The composite is electrically inert, offering little chance of accidental shock due to unintended involvement with stun devices, either in relation to deployment or while holstered. Depending on the precise chemical formulation, the composite may have excellent resistance to solvents, oils used in pepper spray formulations, fire, high heat, marine sea spray, dirt, and high UV exposure (encountered in arid, sunny environments) and may resist shatter, even under cryogenic conditions.

[0048] The invention has been described in detail in connection with various embodiments. These embodiments, however, are merely for example only and the invention is not limited thereto. It will be appreciated by those skilled in the art that other variations and modifications can be easily made within the scope of the invention as defined by the appended claims.

What is claimed is:

1. A personal defense baton comprising:

an elongate shaft defining a void disposed longitudinally therein, the shaft further defining at least one hole through a sidewall thereof.

2. The baton of claim 1, further comprising a handle extending from the shaft.

3. The baton of claim 2, further comprising a bolt, wherein the bolt secures the handle to the shaft, through the at least one hole.

4. The baton of claim 1, wherein the shaft defines a plurality of holes through the sidewall.

5. The baton of claim 4, wherein the holes are arranged symmetrically along a length of the shaft.

6. The baton of claim 4, wherein the holes are arranged symmetrically along a circumference of the shaft.

7. The baton of claim 1, further comprising an enlarged butt end.

8. The baton of claim 7, wherein the butt end is scalloped.

9. The baton of claim 1, wherein the shaft comprises a polyester graphite composite material having a mass-to-length ratio of less than about 6.0 grams/centimeter.

10. A personal defense baton comprising a one-piece, non-mechanical hollow tube adapted to limit blunt trauma injury to a target individual when struck therewith.

11. The baton of claim 10, wherein the hollow tube further defines a plurality of perforations through a sidewall thereof.

12. The baton of claim 11, wherein the plurality of perforations are arranged along the length of the tube.

13. The baton of claim 10, wherein the hollow tube comprises a high strength composite material of sufficient strength to preclude use of metal structural supporting elements.

14. The baton of claim 10, wherein the hollow tube comprises a polyester graphite composite material having a mass-to-length ratio of less than about 6.0 grams/centimeter.

15. A personal defense baton comprising:

an elongate shaft comprising:

a sidewall defining a longitudinal void therein, the sidewall further defining a plurality of apertures therethrough, wherein the apertures are in communication with the void;

a longitudinal axis; and

a polyester graphite composite comprising a mass-to-length ratio of less than about 6.0 g/cm;

a first butt end at a first end of the shaft;

a second butt end at a second end of the shaft;

a handle located intermediate the first butt end and the second butt end, the handle projecting from the shaft at an angle substantially perpendicular to the longitudinal axis; and

means for securing the handle to the shaft via at least one of the apertures.

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