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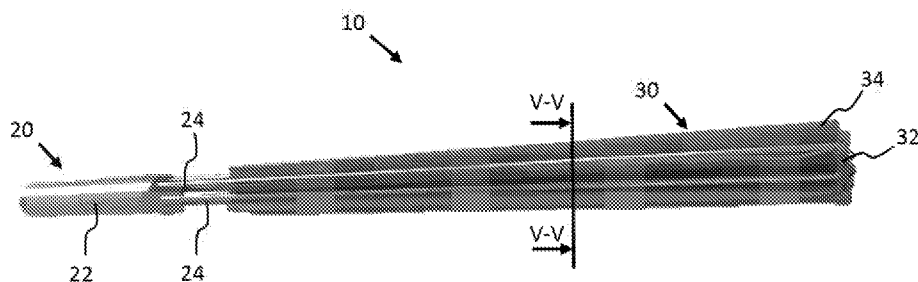
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(54) Title: TWIST ASSEMBLY FIXTURE



(57) Abstract: A method of installation comprising the steps of: (a) connecting an assembly fixture to an insert; (b) inserting the insert into a hollow structure in an insertion direction substantially coaxial with an axis of the hollow structure; and (c) rotating the insert about the axis of the hollow structure during insertion.

TWIST ASSEMBLY FIXTURE

FIELD

[001] The present teachings generally relate to the insertion of a damping device within a cavity, and more particularly, to a method of insertion of a damping device within a cavity of a hollow structure.

BACKGROUND

[0001] A user of any item having a hollow structure (e.g., a transportation vehicle, lawn care device, sporting equipment, or a combination thereof) may experience repetitive vibrations or shock impact in their hands, feet, or both while using the item. The repetitive vibrations may lead to user discomfort, including hand or foot pain, hand or foot numbness, or both requiring the user to stop using the item for a period of time. There have been a variety of mechanisms designed around the damping of vibrations and shock absorption in various items and vehicles. For example, items may include a cushioned or padded grip portion on the item to absorb a portion of the shock before reaching a user's hands or feet (e.g., a rubber grip around a steel golf club shaft). Alternatively, loose particles such as lead balls may be filled in a hollow shaft to help dampen vibration. However, these damping and shock absorption designs require complicated assembly processes, are difficult to form to the contour of a desired item, are expensive to manufacturing, or a combination thereof.

[0002] An alternate damping device may be used for insertion into a hollow structure. The damping device may include a core and one or more extensions extending from the core adapted to be inserted into the hollow structure as a solid piece. The one or more extensions may be flexible to aid in insertion of the damping device within the hollow structure, to help dampen vibration and absorb shock, or both. Frequently, the damping device is inserted in a direction substantially coaxial with a longitudinal axis of the hollow structure so that, when inserted, a diameter of the damping device may be about an inner diameter of the hollow structure. Once inserted, the damping device may be cured with an increased temperature to ensure a tighter fit between the damping device and the hollow structure.

[002] An example of a damping device for a hollow structure can be found in International Publication No. WO 2016/161350, all of which is incorporated by reference herein for all purposes. It would be attractive to have a damping device that may be inserted into a hollow structure that tightly fits along the contour of the inner surface of the hollow structure. What is needed is a flexible damping device that may have a larger diameter than the hollow structure. It would be

attractive to have a method of installation of a damping device within a hollow structure that may be free of secondary operations, such as baking the item. What is needed is an installation technique that may allow for a tightly fitting damping device immediately after insertion of the damping device into the hollow structure. It would be attractive to have a method of installation that may removably secure the damping device to the hollow structure. What is needed is a method of installation that may be reversed to remove the damping device from the hollow structure in a nondestructive manner.

SUMMARY

[003] The present teachings meet one or more of the present needs by providing a method of installation comprising the steps of: (a) connecting an assembly fixture to an insert; (b) inserting the insert into a hollow structure in an insertion direction substantially coaxial with an axis of the hollow structure; and (c) rotating the insert about the axis of the hollow structure during insertion.

[004] The present teachings meet one or more of the present needs by providing a method of installation, wherein the rotation of the insert is simultaneously done with moving the insert in the insertion direction; wherein the rotation is clockwise, counterclockwise, or both; wherein a diameter of the insert is greater than an inner diameter of the hollow structure; wherein the method is free of a step of baking or curing; wherein after insertion, the insert is flush or recessed from an opening of the hollow structure; wherein the hollow structure is one or more apertures of a handle; wherein the handle is a bat handle; wherein after insertion, the insert can be removed from the hollow structure in a nondestructive manner; wherein the insert is removed from the hollow structure by pulling the insert with the assembly fixture in a direction directly opposing the insertion direction; wherein the insert is rotated clockwise, counterclockwise, or both simultaneously with pulling the insert in the opposing direction during removal; or a combination thereof.

[005] The present teachings meet one or more of the present needs by providing an insert comprising a core and a plurality of fins projecting axially away from the core, wherein the fins are flexible, compressible, or both.

[006] The present teachings provide an insert having a larger diameter than a diameter of the hollow structure to which the insert will be inserted. The insert may be installed free of secondary operations, such as baking or curing. The present teachings provide a method of installation that allows for a tightly fitting insert immediately after insertion of the insert within the hollow structure. The present teachings provide a method of installation that allows for removal

of the insert after insertion into the hollow structure. The present teachings provide a method of removal of an insert from a hollow structure in a nondestructive manner.

BRIEF DESCRIPTION OF THE DRAWINGS

- [007] FIG. 1 is a perspective view of an insertion assembly prior to installation within a hollow structure;
- [008] FIG. 2 is a side view of an insertion assembly prior to installation within a hollow structure;
- [009] FIG. 3 is a side view of an insertion assembly prior to installation within a hollow structure;
- [0010] FIG. 4 is a bottom view of a hollow structure having a plurality of apertures;
- [0011] FIG. 5 is cross-sectional view V-V of FIG. 1;
- [0012] FIG. 6 is cross-sectional view VI-VI of FIG. 4, illustrating an insertion assembly being inserted into an aperture of a hollow structure;
- [0013] FIG. 7 is cross-sectional view VI-VI of FIG. 5, illustrating an alternative insertion assembly being inserted into an aperture of a hollow structure;
- [0014] FIG. 8 is a side view of an assembly fixture being secured to an insert; and
- [0015] FIG. 9 is a cross-sectional view of an insertion assembly being removed from an aperture of a hollow structure.

DETAILED DESCRIPTION

[0016] The explanations and illustrations presented herein are intended to acquaint others skilled in the art with the teachings, its principles, and its practical application. Those skilled in the art may adapt and apply the teachings in its numerous forms, as may be best suited to the requirements of a particular use. Accordingly, the specific embodiments of the present teachings as set forth are not intended as being exhaustive or limiting of the teachings. The scope of the teachings should, therefore, be determined not with reference to the description herein, but should instead be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes. Other combinations are also possible as will be gleaned from the following claims, which are also hereby incorporated by reference into this written description.

[0017] This application claims the benefit of filing date of Chinese Application No. 201810651725.5, filed June 22, 2018, the contents of that application being hereby incorporated by reference for all purposes.

[0003] The teachings herein are directed toward devices and the materials for making such devices that can be located into hollow structures for the purposes of vibration damping. These hollow structures may be made of a variety of rigid materials including but not limited to metallic materials and polymeric materials. The hollow structure may be any geometry or shape. For example, any hollow generally tubular structure may be filled. Non-limiting examples include baseball bats, tennis/racquetball rackets, hockey and lacrosse sticks, push lawn mower handles, golf clubs, riding mower zero turn handles (e.g., any heavy equipment with handle type steering), weed whackers, portable generators, hunting stands/ladder stands, chain saw handles, motorcycle/moped/bicycle handle bars and footrests, ultralight aircraft frames, go-kart and other miniaturized vehicle frames, steering wheels, bicycle frames, exercise equipment and vacuum cleaner handles.

[0018] The teachings herein are directed towards an insert and a method of installing the insert into a hollow structure. The insert may function to dampen vibrations, provide shock absorption or both. The insert may dampen vibrations, provide shock absorption, or both within a hollow structure, externally along an outer surface of an object, in between two objects, or a combination thereof. For example, the insert may be inserted into a hollow cavity of an item (e.g., a hole, bore, aperture, etc.) to absorb shock vibrations during impact of the item with an external object. Alternatively, the insert may be inserted two objects such as sandwich panels or a top and bottom platform of a treadmills to absorb shock during impact from a user. The insert may maintain a shape of the hollow structure. For example, the insert may abut an inner surface of the hollow structure such that, upon impact, the hollow structure maintains its shape due to support from the insert. The insert may be structurally reinforcing. The insert may be flexible. The insert may be compressible. The insert may be elastic or inelastic. The insert may vary in size and shape based on a desired application. For example, the insert may be sufficiently circular to fit in a round hole or the insert may be square to fit within a substantially square cavity. The insert may be triangular, round, oval, square, rectangular, trapezoidal, or a combination thereof. The insert may include a core and have one or more projections extending from the core. The insert may be substantially solid or may be hollow. A portion of the insert may be rigid while another portion of the insert may be flexible. For example, a core of the insert may be made of metal while one or more projections extending from the core may be a compressible foam. The insert may be inserted along an entire length of a hollow structure or a portion of the length of the hollow

structure. A single insert may be inserted into a hollow structure or a plurality of inserts may be inserted into a single hollow structure.

[0019] The insert may be made of a uniform material or may comprise a plurality of materials. For example, the insert may be a single extruded polymeric material. Alternatively, the insert may include a metal core and include polymeric projections extending from the core. The insert may be expandable, foamable, or both. The insert may include an adhesive layer that, upon activation, the adhesive layer bonds to an inner surface of the hollow structure. The adhesive layer may be curable at a heightened temperature above room temperature, using an activation material, or both. Alternatively, the insert may be free of a foamable or curable material requiring a secondary operation or curing or baking. The insert may not require a baking or curing step before, after, or during insertion of the insert into a hollow structure. The insert may be a continuous piece or may include a plurality of individual pieces bonded together to form the insert. The individual pieces may be bonded to a core.

[0020] The core may function to support features of the insert, provide structural reinforcement to the insert, or both. The core may provide vibration damping, shock absorption, or both. The core may be any shape, size, configuration, or combination thereof suitable for the preceding. The core may have a shape similar or identical to the shape of a hollow cavity into which it may be inserted. Alternatively, the core may have a shape dissimilar to the shape of a hollow structure to which it may be inserted. For example, the core may be substantially square and include a plurality of projecting fins so that, when the insert is inserted into a round cavity, the fins are compressed to follow a contour of the hollow structure. The core may be partially or completely solid or partially or completely hollow. The core may be rigid, flexible, or have rigid and flexible portions. The core may be sized smaller than a hollow structure so that it may be inserted in the hollow structure. For example, the core may have a diameter smaller than the hollow structure's diameter. The core may be comprised of metal, a polymer, other materials, or a combination thereof. The core may be at least partially formed through extrusion. The core may be a polymeric material including a metal wire embedded therein. A metal wire could be co-extruded with a polymeric material. This may add one or more of weight and stiffness to the core. The core may include high density or metallic portions (e.g., inserts) and such portions may be located at desired locations for added dampening effect. In one example, such portions may be located at outermost sections of a hollow structure. The core may be one straight segment to match a section of a hollow structure or may include multiple segments to match multiple segments of the hollow structure. The core may include contours which match contours of the hollow structure so that the core may be inserted or formed continuously along a longer portion

of the hollow structure. If the core is rigid, it may be designed in the shape of the hollow structure. If the core is flexible, it may bend to match the contours of the hollow structure. The core may include bend zones, which may be weakened areas or hinges along the core's length to aid in the core flexing to match the contours of the hollow structure.

[0021] One or more fins may extend from the core of the insert. The one or more fins may function provide a frictional engagement between the insert and the hollow structure. The one or more fins may function to follow a contour within the hollow structure after insertion. The one or more fins may extend radially outward from the core. The one or more fins may create a space between the core and the inner surface of the hollow structure. For example, each fin may extend approximately 10 mm from the core so that, after insertion, the core is approximately centered along an axis of the hollow structure approximately 10 mm away from the inner surface of the hollow structure. The one or more fins may project from the core and extend an entire length of the core. Alternatively, the one or more fins may extend only a portion of the length of the core. The one or more fins may be any shape, size, configuration, or a combination thereof. There may be any number of the one or more fins. There may be about 4 or more fins, about 8 or more fins, about 12 or more fins, or about 16 or more fins. There may be about 30 or less fins, about 25 or less fins, or about 20 or less fins. The number of fins may be selected to allow for the core to be as small in diameter as possible while still maintaining the structure of the insert, yet the insert may still provide a suitable amount of vibration damping, shock absorption, or a combination thereof. The one or more fins may be concentrated in one or more sections or portions of the core. The one or more fins may include a desired height. The height may be measured as a distance from where the one or more fins is adjacent to the outer surface of the core to a peripheral edge of the one or more fins. An outer diameter of the insert may be measured as a diameter or cross-sectional height of the core plus the height of one or more fins at a cross-section of the insert. The outer diameter of the insert may be defined at the largest cross-section between outer surfaces of the insert. For example, the outer diameter may be measured from peripheral edges of two fins on opposing sides of the core. The one or more fins may have a height such that the total diameter or height of the insert is about less than, equal to, or greater than the diameter or height of the hollow structure.

[0022] The one or more fins may be made of a polymeric material or any other material capable of any of the preceding or following features. The one or more extensions may be extruded over the core, may be adhered or mechanically fastened to the core, and/or may be molded with the core. For example, the one or more fins may be co-extruded with the core to create a uniform insert. Alternatively, the one or more fins may be fastened to the core using one

or more fasteners. The one or more fasteners may include bolts, screws, nails, clips, loop and hook fasteners, rivets, or a combination thereof. The one or more fins may come in a variety of shapes. The one or more fins may be shaped as one or more continuous fins with a constant or varying thickness extending along all or part of the length of the core. The one or more fins may be shaped as thin planar members, pins, rods, tubes, bars, wings, radial wings, partial radial wings, radial barbs, partial radial barbs, the like, or a combination thereof. The one or more fins may be spaced along the length of the core in a repetitive pattern. The one or more fins may be radially spaced around the core in an alternating pattern. The one or more extensions may encircle an outer diameter of the cored and be spaced along the length of the core.

[0023] The one or more fins may be flexible. The flexibility may aid in assembling the insert into a hollow structure. For example, the one or more fins may bend or collapse with pressure. The pressure may be the or force exerted by the hollow structure's interior wall as the insert is inserted into the hollow structure. The one or more fins may be located on an angle relative to the hollow structure's outer surface. For example, a fin may be located on an acute angle relative to the core's outer surface so that each fin first enters the hollow structure where it abuts the core's outer surface. The acute angle may provide for less resistance in the direction of insertion of the insert while providing increased friction in the direction opposite the insertion direction. The one or more fins may bend or collapse opposite the direction of insertion. For example, as a fin enters the hollow structure and upon application of pressure from the hollow structure, the peripheral edges of the fin may be bent toward the core so that they are closer to the core's outer surface. The one or more fins may frictionally engage an assembly fixture.

[0024] The assembly fixture may function to engage the insert and aid in installation of the insert into a hollow structure. The assembly fixture may allow a user to push in an insertion direction, pull the insert in a removal direction, rotate the insert, or a combination thereof free of directly contacting the insert. For example, the assembly fixture may include a base or handle so that once the assembly fixture is engaged to the insert, a user may move the insert by only contacting the base or handle. The assembly fixture may be structurally rigid. The assembly fixture may include one or more engaging features to connect to the insert. The assembly fixture may removably attach to the insert. The assembly fixture may include one or more locking mechanisms to secure the insert after connection. The assembly fixture may be removably attached to the insert so that, after insertion of the insert within a hollow structure, the assembly fixture may be removed while the insert remains in the hollow structure. The assembly fixture may have a diameter greater than, less than, or equal to a diameter of the insert. The assembly fixture may have a diameter greater than, less than, or equal to a diameter or height of the hollow

structure. For example, the assembly fixture may include a base having a diameter greater than an aperture so that the base abuts an exterior opening of the hollow structure to ensure proper alignment of the insert within the hollow structure. Alternatively, the entire assembly fixture may have a diameter less than a diameter of the hollow structure so that the assembly fixture may be inserted into the hollow structure.

[0025] The assembly fixture may include a base. The base may function to provide a user a handle to maneuver the assembly fixture, maneuver the insert attached to the assembly fixture, or both. The base may function as structure support for one or more features of the assembly fixture. The base may include one or more attachment features for one or more the one or more features connected to the assembly fixture. For example, the base may include one or more holes, one or more hooks, one or more clips, or a combination thereof to connect one or more features to the base. The base may be shaped substantially similar to a hollow structure or may be dissimilar. The base may include a diameter greater than, less than, or equal to a diameter or height of a hollow structure. The base may be compressible. The base may be structurally rigid. The base may include one or more projections extending away from a surface of the base. For example, the base may include one or more fingers projecting away from a distal end of the base.

[0026] The one or more fingers may function to engage the insert. The one or more fingers may engage the core of the insert, the one or more fins of the insert, or both. For example, the one or more fingers may frictionally engage the core of the insert and be spaced apart so that the one or more fingers are positioned between the one or more fins of the insert. The one or more fingers may have a length less than, greater than, or equal to a length of the insert. The one or more fingers may be a plurality of fingers. For example, the assembly fixture may include about 2 or more fingers, about 4 or more fingers, or about 6 or more fingers. The assembly fixture may include about 12 or less fingers, about 10 or less fingers, or about 8 or less fingers. The one or more fingers may be structurally rigid or may be flexible. The one or more fingers may include a friction surface to aid in frictionally engaging the insert. The one or more fingers may be removably attached to the insert so that the assembly fixture may be connected to the insert, disconnect from the insert, or both free of damage to the insert. The one or more fingers may extend or project from any surface of the base. The one or more fingers may be uniform in size and shape or may be dissimilar. The one or more fingers may be integrally formed with the based or may be connected to the base.

[0027] The one or more fingers may be any shape and size desired based on a desired application. The one or more fingers may connect to the insert so that the insert and the assembly

fixture form an insertion assembly. The insertion assembly functions to allow a user to insert the insert within a hollow structure using the assembly fixture. The insertion assembly may be formed prior to inserting the insert within the hollow structure. Alternatively, the insertion assembly may be formed after the insert is located within the hollow structure. For example, the assembly fixture may engage an insert located within an aperture of the hollow structure so that the insert may be removed from the aperture.

[0028] The aperture may function as a cavity that receives insert. The aperture may function to form an inner contoured surface for the insert. The aperture may be any size, shape, depth, or a combination thereof. The aperture may extend through an entire length of the hollow structure or a portion of the length of the hollow structure. The aperture may include one or more rounded or chamfered terminal edges to aid with insertion of the insert. The aperture may have a shape substantially similar to a shape of the core of the insert, a shape of the fins with the core of the insert, or both. For example, the aperture may be tubular to receive a tubular core of the insert. A plurality of apertures may be located within a single hollow structure. For example, the hollow structure may be a handle of a baseball bat that includes a plurality of apertures bored into the handle. Each of the plurality of apertures may receive an insert, or only a portion of the apertures may receive an insert. Each aperture may receive a similar insert, or a portion of the apertures may receive a different shaped insert. Each of the plurality of apertures may be sized and shaped similarly or dissimilarly. A diameter of the aperture may be greater than, less than, or equal to a diameter of the insert, a diameter of the assembly fixture, or both. For example, a diameter of the insert measured from opposing fins may be greater than a diameter of the aperture and a diameter of the core of the insert may be less than a diameter of the aperture so that, when inserted, a plurality of fins of the insert are compressed to match a diameter of the aperture and substantially follow a contour of the inner surface of the aperture.

[0029] The insert may be installed within a hollow structure or aperture using the assembly fixture. The assembly fixture may be secured to the insert by moving the one or more fingers in a direction of assembly towards the insert, thereby engaging the one or more fingers with the one or more fins of the insert, the core of the insert, or both. After the assembly fixture has engaged the insert and an insertion assembly has been formed, the insert may be inserted into the hollow structure or aperture in an insertion direction substantially coaxial with an axis or centerpoint of the hollow structure or aperture. Alternatively, insertion direction may be at an angle other than coaxial with the axis or center point of the hollow structure or aperture. For example, the insertion direction may form an angle with the axis or centerpoint of the hollow structure or aperture of about 0 degrees or greater, about 15 degrees or greater, or about 30

degrees or greater. The angle may be about 75 degrees or less, about 60 degrees or less, or about 45 degrees or less. The angle may fluctuate during installation of the insert. For example, the insertion direction may be about 15 degrees when initially inserting the insert, but gradually decrease to approximately 0 degrees (i.e., substantially coaxial) as the insert continues to move in the insertion direction within the hollow structure or cavity.

[0030] During insertion of the insert, the insert may also be rotated. The rotation of the insert may be performed using the assembly fixture. The rotation may be clockwise, counterclockwise, or both. The rotation may be completed simultaneously when moving the insert in the insertion direction. For example, the insert may be rotated and moved in the insertion direction at the same time to aid in installation of the insert within the hollow structure or cavity. The rotation may be completed sequentially relative to moving the insert in the insertion direction. For example, the insert may be incrementally moved in the insertion direction for a desired distance, stopped, and rotated clockwise, counterclockwise, or both to decrease friction between the insert and the hollow structure or aperture. Rotation of the insert during assembly may be done about an axis of rotation of the hollow structure or aperture, an axis of rotation of the insert, and axis of rotation of the assembly fixture, or a combination thereof. Rotation of the insert may be completed about any angle relative to the axis of rotation of the hollow structure or aperture. For example, the axis of rotation of the insert and the axis of rotation of the hollow structure or aperture may form an angle of about 0 degrees or more, about 5 degrees or more, or about 10 degrees or more. The angle may be about 20 degrees or less, about 15 degrees or less, or about 12 degrees or less. Rotation of the insert may be any degree of rotation about the axis of rotation. For example, the insert may be rotated about 45 degrees or more, about 90 degrees or more, about 135 degrees or more, or about 180 degrees or more. The insert may be rotated about 360 degrees or less, about 315 degrees or less, about 270 degrees or less, or about 225 degrees or less. The insert may be rotated more than 360 degrees. For example, the insert may make one or more full rotations during insertion.

[0031] Rotation of the insert and movement of the insert in the insertion direction may be done in a continuous manner or may be completed incrementally. For example, rotation and movement of the insert in the insertion direction may be completed in one single action from a machine that both rotates and moved the insert simultaneously to reach a desired location within the hollow structure or aperture. Alternatively, the rotation and movement in the insertion direction may be done in incremental stages of a desired distance within the hollow structure or aperture so that a plurality of movements may be completed prior to installation of the insert being completed.

[0032] The insert may be removed from a hollow structure or aperture in a similar manner to insertion. The assembly fixture may be secured to an insert already positioned within a hollow structure or aperture. Once secured, the insert may be removed in a direction substantially opposing the insertion direction. During removal, the insert may be rotated in a direction substantially similar or substantially opposing the direction of rotation during insertion. For example, the insert may be rotated clockwise during insertion and be rotated counterclockwise during removal. Alternatively, the insert may be rotated clockwise or counterclockwise both during insertion and removal. The rotation may be completed during removal simultaneously with moving the insert in a removal direction or may be completed incrementally. Removal of the insert may be completed in a nondestructive manner such that the insert may be removed from a hollow structure or cavity and be inserted into a different hollow structure or cavity. As such, the inserts may be reusable or interchangeable between different items. For example, the inserts may be removed from a first handle and inserted into a second handle. Insertion and removal may be completed in a manufacturing plant, by an end user or customer, or both.

[0033] Turning now to the figures, **FIG. 1** illustrates a perspective view of an insertion assembly 10. The insertion assembly 10 may be configured to be inserted into a hollow structure, such as an aperture of a hollow structure (see FIGS. 6 and 7). The insertion assembly 10 includes an assembly fixture 20 connected to an insert 30. The assembly fixture 20 includes a plurality of fingers 24 protruding axially from a base 22. The plurality of fingers 24 are configured to extend around a core 32 of the insert 30 in between a plurality of fins 34 projecting radially away from the core 32. It should be noted that the assembly fixture 20 may be removably secured to the insert 30 so that once the insert 30 is inserted into a hollow structure, the assembly fixture 20 may be removed and the insert 30 may remain inside the hollow structure (see FIG. 8).

[0034] **FIG. 2** illustrates a side view of an insertion assembly 10. The insertion assembly 10 may be configured to be inserted into a hollow structure, such as an aperture of a handle (see FIGS. 6 and 7). The insertion assembly 10 includes an assembly fixture 20 connected to an insert 30 via a plurality of fingers (not shown) extending from a base 22 of the assembly fixture 20. As shown, a diameter of the insert D_I and a diameter of the assembly fixture D_F are substantially the same so that the insert 30 and the assembly fixture 20 may extend into the hollow structure.

[0035] **FIG. 3** illustrates a side view of an insertion assembly 10. The insertion assembly 10 may be configured to be inserted into a hollow structure, such as an aperture of a handle (see FIGS. 6 and 7). The insertion assembly 10 includes an assembly fixture 20 connected to an insert 30 via a plurality of fingers (not shown) extending from a base 22 of the assembly fixture 20. As shown, a diameter of the insert D_I is greater than a diameter of the assembly fixture D_F so that,

when the insert 30 is inserted into a hollow structure, the insert 30 is compressed to a diameter approximately equal to the diameter of the assembly fixture D_F .

[0036] FIG. 4 illustrates a bottom view of a hollow structure 40. The hollow structure 40 includes a plurality of apertures 42 positioned around and extending through the hollow structure 40.

[0037] FIG. 5 illustrates cross-sectional view V-V of FIG. 1. As shown, a plurality of fingers 24 of the assembly fixture are extending between the plurality of fins 34 radially projecting from the base 32 of the insert 30, thereby securing the insert 30 to the assembly fixture (see FIGS. 1-3).

[0038] FIG. 6 illustrates cross-sectional view VI-VI of the hollow structure 40 of FIG. 4. An insertion assembly 10 is shown being inserted into one of the plurality of apertures 42 of the hollow structure 40. The insertion assembly 10 includes an assembly fixture 20 connected to an insert 30 via a plurality of fingers (not shown) extending from a base 22 of the assembly fixture 20. The insert 30 is inserted into the aperture 42 in a direction I via the assembly fixture 20. As the insert 30 moves in direction I, the insert 30 is simultaneously rotated in direction R_1 to ease insertion. It should be noted that the insert 30 may also be rotated and moved in direction I in an alternating manner instead of simultaneously.

[0039] FIG. 7 illustrates cross-sectional view VI-VI of the hollow structure 40 of FIG. 4. An insertion assembly 10 is shown being inserted into one of the plurality of apertures 42 of the hollow structure 40. The insertion assembly 10 includes an assembly fixture 20 connected to an insert 30 via a plurality of fingers (not shown) extending from a base 22 of the assembly fixture 20. The insert 30 is inserted into the aperture 42 in a direction I via the assembly fixture 20. As the insert 30 moves in direction I, the insert 30 is simultaneously rotated in direction R_1 to ease insertion. During insertion, the insert 30 is compressed so that the insert 30 may substantially follow the contour of the inner surface of the aperture 42. It should be noted that the insert 30 may also be rotated and moved in direction I in an alternating manner instead of simultaneously.

[0040] FIG. 8 illustrates a side view of an assembly fixture 20 being secured to an insert 30. A plurality of fingers 24 extending axially away from a base 22 are secured around a core of the insert 30 by moving the assembly fixture 20 in an assembly direction A. It should be noted that the assembly fixture 20 may be removably secured to the insert 30 so that once the insert 30 is inserted into a hollow structure, the assembly fixture 20 may be removed and the insert 30 may remain inside the hollow structure.

[0041] FIG. 9 illustrates a cross-sectional view of an insertion assembly 10 being removed from an aperture 42 of a hollow structure 40. The insertion assembly 10 includes an assembly

fixture 20 connected to an insert 30 via a plurality of fingers (not shown) extending from a base 22 of the assembly fixture 20. The insert 30 is removed from the aperture 42 in a direction RE via the assembly fixture 20. As the insert 30 moves in direction RE, the insert 30 is simultaneously rotated in direction R_R to ease removal. It should be noted that the insert 30 may also be rotated and moved in direction RE in an alternating manner instead of simultaneously. It should also be noted that the insert 30 may be removed in a nondestructive manner so that the insert 30 may be used in another hollow structure.

[0042] The explanations and illustrations presented herein are intended to acquaint others skilled in the art with the invention, its principles, and its practical application. The above description is intended to be illustrative and not restrictive. Those skilled in the art may adapt and apply the invention in its numerous forms, as may be best suited to the requirements of a particular use.

[0043] Accordingly, the specific embodiments of the present invention as set forth are not intended as being exhaustive or limiting of the teachings. The scope of the teachings should, therefore, be determined not with reference to this description, but should instead be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. The omission in the following claims of any aspect of subject matter that is disclosed herein is not a disclaimer of such subject matter, nor should it be regarded that the inventors did not consider such subject matter to be part of the disclosed inventive subject matter.

[0044] Plural elements or steps can be provided by a single integrated element or step. Alternatively, a single element or step might be divided into separate plural elements or steps.

[0045] The disclosure of "a" or "one" to describe an element or step is not intended to foreclose additional elements or steps.

[0046] While the terms first, second, third, etc., may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be used to distinguish one element, component, region, layer or section from another region, layer or section. Terms such as "first," "second," and other numerical terms when used herein do not imply a sequence or order unless clearly indicated by the context. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings.

[0047] Spatially relative terms, such as "inner," "outer," "beneath," "below," "lower," "above," "upper," and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. Spatially

relative terms may be intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as “below” or “beneath” other elements or features would then be oriented “above” the other elements or features. Thus, the example term “below” can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0048] The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes. Other combinations are also possible as will be gleaned from the following claims, which are also hereby incorporated by reference into this written description.

[0049] List of Elements:

[0050]	10	Insertion Assembly
[0051]	20	Assembly Fixture
[0052]	22	Base
[0053]	24	Finger
[0054]	30	Insert
[0055]	32	Core
[0056]	34	Fin
[0057]	40	Hollow Structure
[0058]	42	Aperture
[0059]	DF	Diameter of Assembly Fixture
[0060]	DI	Diameter of Insert
[0061]	I	Direction of Insertion (of Insert)
[0062]	RE	Direction of Removal
[0063]	A	Direction of Assembly (of Insert on Assembly Fixture)
[0064]	RI	Direction of Rotation for Insertion
[0065]	RR	Direction of Rotation for Removal

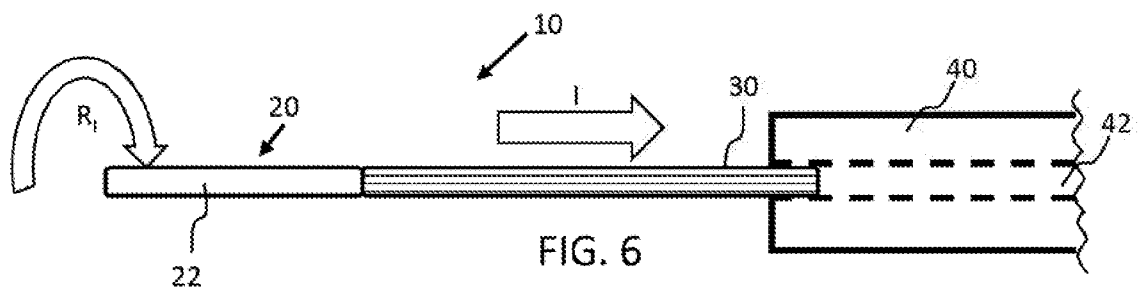
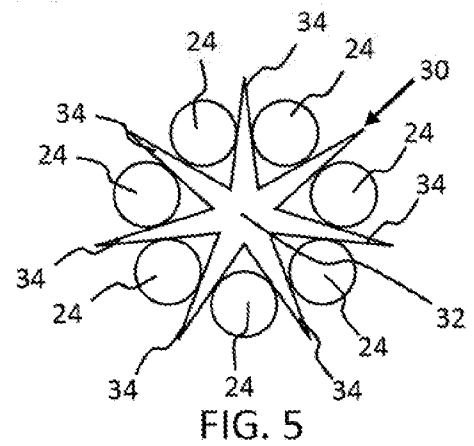
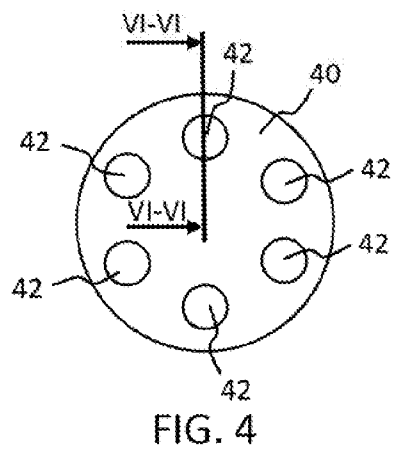
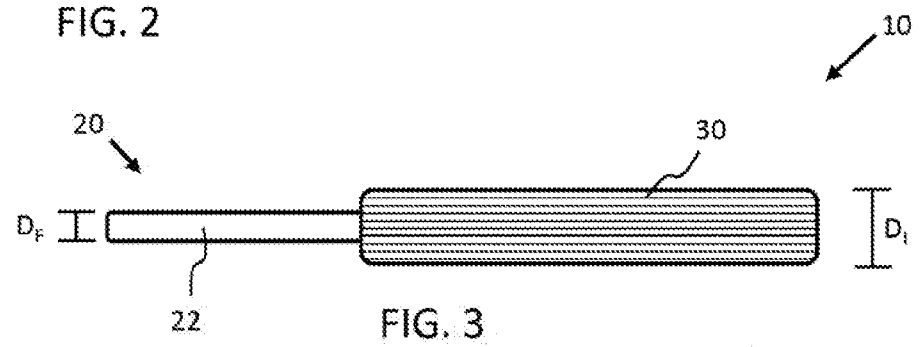
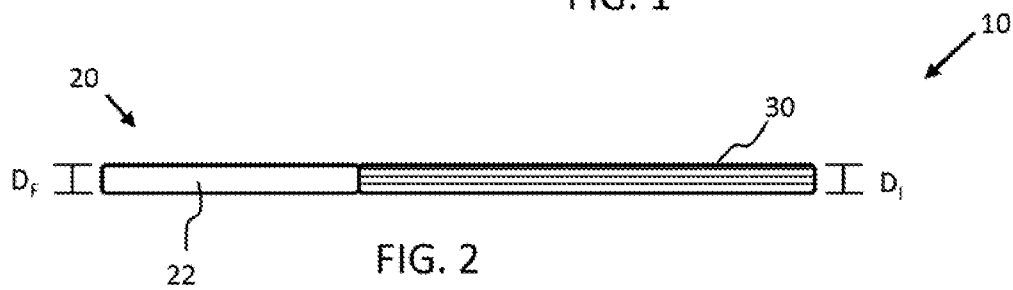
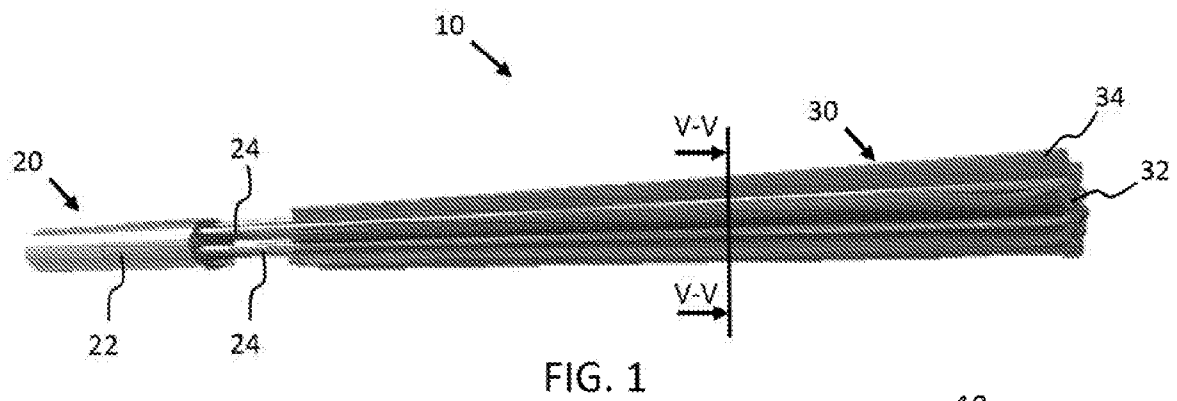
CLAIMS

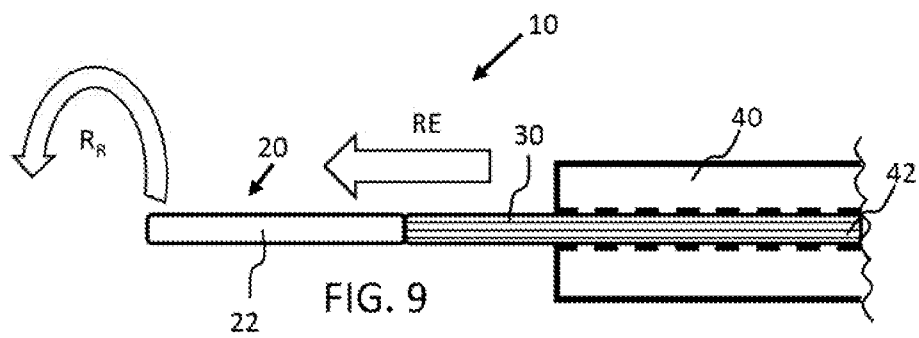
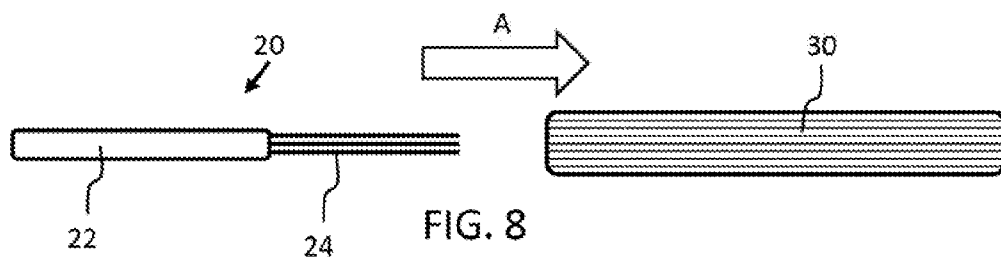
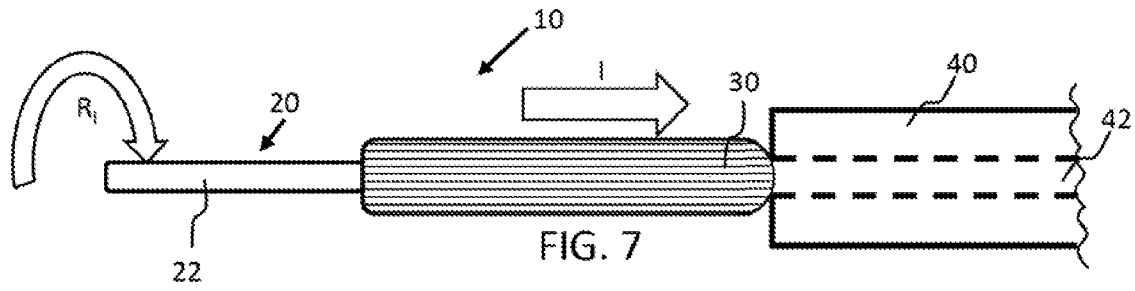
What is claimed is:

1. A method of installation comprising the steps of:
 - a. connecting an assembly fixture to an insert;
 - b. inserting the insert into a hollow structure in an insertion direction substantially coaxial with an axis of the hollow structure; and
 - c. rotating the insert about the axis of the hollow structure during insertion.
2. The method according to claim 1, wherein the rotation of the insert is simultaneously done with moving the insert in the insertion direction.
3. The method according to claim 1 or 2, wherein the rotation is clockwise, counterclockwise, or both.
4. The method according to any of the preceding claims, wherein a diameter of the insert is greater than an inner diameter of the hollow structure;
5. The method according to any of the preceding claims, wherein the method is free of a step of baking or curing.
6. The method according to any of the preceding claims, wherein after insertion, the insert is flush or recessed from an opening of the hollow structure.
7. The method according to any of the preceding claims, wherein the hollow structure is one or more apertures of a handle.
8. The method according to claim 7, wherein the handle is a bat handle.
9. The method according to any of the preceding claims, wherein after insertion, the insert can be removed from the hollow structure in a nondestructive manner.
10. The method according to claim 9, wherein the insert is removed from the hollow structure by pulling the insert with the assembly fixture in a direction directly opposing the insertion direction.

11. The method according to claim 10, wherein the insert is rotated clockwise, counterclockwise, or both simultaneously with pulling the insert in the opposing direction during removal.
12. The method according to any of the preceding claims, wherein the insert comprises a core and a plurality of fins projecting axially away from the core.
13. The method according to claim 12, wherein the fins are flexible, compressible, or both.
14. The method according to claim 12, wherein the assembly fixture includes a plurality of fingers extending from a base and the fingers are inserted between the fins of the insert to secure the insert to the assembly fixture.
15. The method according to any of the preceding claims, wherein after insertion, the insert abuts a contour of an inner surface of the hollow structure.
16. The method according to any of the preceding claims, wherein the insert is configured to dampen vibrations of the hollow structure.
17. The method according to any of the preceding claims, wherein the insert provides shock absorption during impact of the hollow structure.
18. A baseball bat comprising a plurality of inserts inserted into a plurality of apertures located within a handle of the bat according to the method of any of the preceding claims.
19. The method according to any of the preceding claims, wherein a diameter of the insert is greater than a diameter of the assembly fixture.
20. The method according to any of the preceding claims, wherein the method eliminates permanent distortion of the insert during insertion and reduces scrap rate.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/038607

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16F1/373 A63B59/50 A63B60/54
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16F A63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2018/015342 A1 (VAN NGUYEN THU [US] ET AL) 18 January 2018 (2018-01-18) figures 3,6 -----	1-8, 15-20 12-14
X	US 4 951 948 A (PENG JUNG C [TW]) 28 August 1990 (1990-08-28) figure 3 -----	1,9-11
X	US 2017/363123 A1 (BYUN MINHYUNG [KR] ET AL) 21 December 2017 (2017-12-21) figure 2 -----	1
X	CN 206 881 149 U (LUO DEMING) 16 January 2018 (2018-01-16) figure 2 ----- -/-	1



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

13 September 2019

Date of mailing of the international search report

23/09/2019

Name and mailing address of the ISA/

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Authorized officer

Beaumont, Arnaud

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/038607

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

International application No

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