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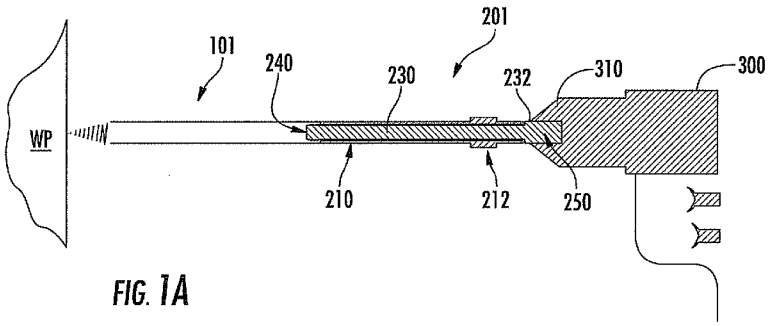

FIG. 1A

(57) Abstract: Screw driver-holder apparatuses, systems and methods are provided and can include a screw and a screwdriver. The screw can include a threaded screw body and a screw head, and the screw head can include a socket and a screw head surface surrounding the socket. The screwdriver can include a hollow sleeve with a longitudinal bore and a first end defining a screw engagement surface and a driving shaft positioned within the longitudinal bore of the hollow sleeve and rotatable relative to the hollow sleeve. The driving shaft can further include a first end extending beyond the first end of the hollow sleeve, a second end opposite the first end, and a stop restricting axial movement of the sleeve towards the second end of the driving shaft. The first end can include a protruding tip adapted for engaging the socket of the screw head.

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DESCRIPTION

SCREW HOLDER-DRIVER APPARATUSES, SYSTEMS AND METHODS

CROSS REFERENCE TO RELATED APPLICATION

The presently disclosed subject matter claims the benefit of U.S. Provisional Patent Application Serial No. 61/351,695, filed June 4, 2010, the disclosure of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The subject matter disclosed herein relates generally to screw holders and screwdrivers. More particularly, the subject matter disclosed herein relates to apparatuses, systems and methods for securely and releasably holding a screw on a screwdriver.

BACKGROUND

In many situations it is desirable that a screw be securely attached to a screwdriver. Such an arrangement enables the operator to place the screw into the screw hole with one hand because it is not necessary to use a hand to hold the screw on the driver. Further, when firmly attached, "buckling" of the screw-screwdriver assembly can be prevented if the operator accidentally tries to drive the screw slightly off-angle. In addition, in some situations when trying to place a screw down into a small hole, there sometimes is not room for the operator's finger to hold the screw on the end of the screwdriver. For example, in the case of surgical screws, once the screw and driver are turned downward into the surgical wound, if the screw falls off the driver, it can be lost in the wound. Further in regard to surgical screws, when working under poor visualization due to a limited dissection and other causes of poor exposure (e.g., minimally invasive surgery), if the screw misses the predrilled hole and slips off the bone, it can plunge into the surrounding muscle. Likewise, when the screwdriver is pulled back it leaves the screw in the surrounding tissue if the screw is not firmly attached to the driver. Retrieving such a lost screw can be extremely problematic.

Although many attempts have been made to provide secure attachment of screws to their drivers, almost all of these devices function by providing "fingers" disposed around the screwhead that grasp the screw and hold it on the driver. Some such devices are stoutly designed and might function to hold the screw securely, but they do so at the cost of being large and bulky, which is especially undesirable in minimally invasive surgery. In addition, such devices are frequently exceedingly complex and would not tolerate surgical autoclaving. Also, such fingers tend to become caught under the head of the screw when it is fully inserted. When the fingers catch under the head of the screw in this way, the screw must be loosened to remove the fingers and then retightened. Thus, although such devices are currently in use in orthopedic surgery, they have significant limitations.

Alternatively, some devices function by having a hexagonal tip screwdriver in which the tip expands within the head of the screw thus gripping the hex socket in the screw from the inside. This kind of fixation is not very secure, however, and such devices are known to drop screws in use. They can also require multiple hands to assemble the screw to the screwdriver (e.g., one holds the screw, another holds the driver, a third tightens the ring that expands the tip of the screwdriver).

Some devices are designed to be used with special screws that have internal threads on the heads of the screws. Thus, compared to the hexagonal tip devices, these systems can provide more secure fixation, but they can still have the disadvantage of requiring that the operator tighten the screw onto the driver (e.g., a three hand operation), then assemble the driver onto the power driving tool before using it. Then, after insertion of the screw, the power tool must be removed from the driver to allow the bolt that holds the screw on the driver to be removed, and this removal step can often require the use of even another tool to loosen the bolt.

Accordingly, although a variety of different screwdriver designs have been used to address the problem of screw-screwdriver fixation, each of these designs has significant flaws. As a result, it would be desirable for apparatuses and methods to be developed for securely yet releasably holding a screw on a screwdriver.

SUMMARY

In accordance with this disclosure, apparatuses, systems and methods for securely and releasably holding a screw on a screwdriver are provided. In one aspect, a screwdriver assembly is provided. The screwdriver assembly can comprise a hollow sleeve comprising a longitudinal bore and a first end defining a screw engagement surface and a driving shaft positioned within the longitudinal bore of the hollow sleeve and rotatable relative to the hollow sleeve. In addition, the driving shaft can comprise a first end extending beyond the first end of the hollow sleeve, a second end opposite the first end, and a stop restricting axial movement of the sleeve towards the second end of the driving shaft. The first end can comprise a protruding tip adapted for engaging a corresponding socket in a head of a screw.

In another aspect, a method for driving a screw is provided. The method can comprise positioning a driving shaft within a longitudinal bore of a hollow sleeve, the driving shaft rotatable relative to the hollow sleeve, and connecting a screw to the driving shaft by engaging a protruding tip of the driving shaft with a corresponding socket in a head of the screw. When the protruding tip is at least partially engaged with the socket of the screw, a first end of the hollow sleeve can contact the head of the screw. The method can further comprise rotating one or both of the driving shaft or the hollow sleeve in a first direction to advance the screw, and rotating the driving shaft in a second direction opposite the first direction to disengage the protruding tip from the socket of the screw.

In yet another aspect, the present subject matter provides a fixation system comprising a screw and a screwdriver. The screw can comprise a threaded screw body and a screw head, the screw head comprising a socket and a screw head surface surrounding the socket. The screwdriver can comprise a hollow sleeve comprising a longitudinal bore and a first end defining a screw engagement surface and a driving shaft positioned within the longitudinal bore of the hollow sleeve and rotatable relative to the hollow sleeve. The driving shaft can further comprise a first end extending beyond the first end of the hollow sleeve, the first end comprising a protruding tip

adapted for engaging the socket of the screw head, a second end opposite the first end, and a stop restricting axial movement of the sleeve towards the second end of the driving shaft.

In still another aspect, the present subject matter provides a screw comprising a threaded screw body adapted for engagement of a material such as wood or bone and a screw head. The screw head can comprise an internally-threaded socket adapted for engaging an externally-threaded driving shaft of a screwdriver.

Although some of the aspects of the subject matter disclosed herein have been stated hereinabove, and which are achieved in whole or in part by the presently disclosed subject matter, other aspects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present subject matter will be more readily understood from the following detailed description which should be read in conjunction with the accompanying drawings that are given merely by way of explanatory and non-limiting example, and in which:

Figures 1A and 1B are side cutaway views of a screw holder and screwdriver assembly in two different operating states according to an embodiment of the presently disclosed subject matter;

Figures 2A and 2B are side cutaway views of a screw holder and screwdriver assembly in two different operating states according to an embodiment of the presently disclosed subject matter;

Figure 3 is a perspective view of a screw for use with a screw holder and screwdriver assembly according to an embodiment of the presently disclosed subject matter;

Figures 4A, 4B, and 4C are perspective views of screw holder and screwdriver assemblies for use with the screw shown in Figure 3;

Figure 5A is a perspective view of a screw for use with a screw holder and screwdriver assembly according to an embodiment of the presently disclosed subject matter;

Figure 5B is a perspective view of a screw holder and screwdriver assembly for use with the screw shown in Figure 5A;

Figure 6A is a perspective view of a screw for use with a screw holder and screwdriver assembly according to an embodiment of the presently disclosed subject matter;

Figure 6B is a perspective view of a screw holder and screwdriver assembly for use with the screw shown in Figure 6A; and

Figure 7 is a perspective view of a holder adapted to hold screws for use with a screw holder and screwdriver assembly according to an embodiment of the presently disclosed subject matter.

DETAILED DESCRIPTION

The present subject matter provides apparatuses, systems, and methods for securely yet releasably holding a screw on a screwdriver. Specifically, a driver, which can be normally be attached to a power driving tool, can have a threaded tip which can mate with a threaded socket in the head of a screw. An operator can simply hold the screw to the end of the driver and rotate the driver (e.g., by operating a connected power driving tool briefly in the forward direction) to attach the screw to the driver. The operator can place the tip of the screw in position on the target workpiece (e.g., a bone, a plate) and again use the driver to insert the screw (e.g., by again operating the driving tool in the forward direction). Once the screw is inserted, the operator can use the driver (e.g., by operating the driving tool briefly in the reverse direction) to cause the driver to drop off the screw, allowing the operator to move on to the next screw insertion procedure.

For example, in one aspect, the present subject matter provides apparatuses, systems, and methods for holding and driving a pin or screw, generally designated **101**, using a first screwdriver assembly, generally designated **201**. As shown in Figures 1A and 1B, first screwdriver assembly **201** can comprise a hollow sleeve generally designated **210** defining a longitudinal bore there through and a driving shaft **230** positioned within the longitudinal bore of sleeve **210** and longitudinally movable and rotatable relative to sleeve **210**. Driving shaft **230** can comprise a first end **240**

adapted for engaging a corresponding socket in a head of pin **101**. For example, first end **240** can be adapted to be inserted into and secured to an end of pin **101**. Specifically, first end **240** can comprise a threaded tip that can engage a correspondingly threaded internal bore of pin **101**. Driving shaft **230** can further comprise a second end **250** opposite first end **240**, and a stop **232** restricting axial movement of sleeve **210** towards second end **250** of driving shaft **230**.

To drive pin **101** using first screwdriver assembly **201**, a driving tool **300** (e.g., a power drill) can be connected to second end **250** of driving shaft **230**, such as by gripping second end **250** with a chuck **310** as shown in Figure 1A. First end **240** of driving shaft **230** can engage pin **101** (e.g., first end **240** can engage a threaded socket in pin **101**), and sleeve **210** can slide over driving shaft **230** towards pin **101**. Because stop **232** only allows driving shaft **230** to extend a predetermined distance through sleeve **210**, a point can be reached at which driving shaft **230** cannot be advanced further into the end of pin **101**, and so further advancement of driving shaft **230** causes pin **101** to be turned and thus advanced. Accordingly, in this state, rotation of driving shaft **230** can thus drive pin **101** into a work piece **WP** (e.g., a bone, a plate).

When pin **101** is driven to a desired depth, reversing the above procedure can disengage driving shaft **230** from the end of pin **101**. In particular, where first end **240** comprises a threaded tip, reversing the driving direction of driving tool **300** can unscrew driving shaft **230** from the end of pin **101** and thus disengage first screwdriver assembly **201** from pin **101**. In situations where the friction between sleeve **210** and driving shaft **230** (e.g., friction of contact at stop **232**) is greater than the friction between pin **101** and work piece **WP**, sleeve **210** can be braced against rotation to prevent movement of sleeve **210** as driving shaft **230** is rotated. In this regard, sleeve **210** can comprise a grippable portion **212**, such as a portion having a hexagonal cross-section that can be securely grasped by a wrench, which can be engaged by a wrench or similar tool to hold sleeve **210** in place while driving shaft **230** is rotated. In this way, driving shaft **230** can be rotated in a reverse direction relative to sleeve **210** to disengage from pin **101**.

If the user desires to unscrew pin **101** instead of disengaging first screwdriver assembly **201** from pin **101**, the operator can connect driving tool **300** to sleeve **210** rather than to driving shaft **230**, such as by gripping sleeve **210** with chuck **310** as shown in Figure 1B. Because when driving shaft **230** is engaged with the end of pin **101**, sleeve **210** is effectively locked between the end of pin **101** and stop **232**, sleeve **210** can exert a force on pin **101**. Accordingly, by rotating sleeve **210** in reverse, pin **101** can likewise be rotated in a reverse direction to remove it from work piece **WP**, whereas similar reverse rotation of driving shaft **230** would only cause driving shaft **230** to disengage from pin **101** as discussed herein above.

In another aspect, the present subject matter provides an alternative configuration for a second screwdriver assembly, generally designated **202**, shown in Figures 2A and 2B. Similar to the configuration described above with reference to first screwdriver assembly **201**, second screwdriver assembly **202** can comprise a driving shaft **230** that can be adapted for engaging a corresponding socket in a head of a screw, generally designated **102**, which can have an integral head **110**. Specifically, for example, driving shaft **230** can be screwed into a central threaded hole in head **110** of screw **102**. A sleeve **210** positioned about driving shaft **230** can prevent driving shaft **230** from "bottoming" in the socket and binding. Once inserted and at least slightly tight, the operator can insert screw **102** into a work piece **WP** (e.g., a bone) by rotating driving shaft **230**.

Contrary to the first configuration, however, driving shaft **230** according to the subject matter of this aspect can comprise a shaft handle **234** that can serve multiple functions. First, shaft handle **234** can act as a stop for restricting axial movement of sleeve **210** towards second end **250** of driving shaft **230** (i.e., similar to stop **232**). In addition, shaft handle **234** can act as a hand grip for manual rotation of driving shaft **230**. Similarly, sleeve **210** can comprise a sleeve handle **214**, which can act as a hand grip for manual rotation of sleeve **210**. A slide lock **216** can be moved to engage sleeve handle **214** to shaft handle **234** for rotation of sleeve **210** and driving shaft **230** together. For example, slide lock **216** can have internal grooves to

span the gap between the handles to rotationally lock sleeve **210** and driving shaft **230** together.

In this arrangement, driving shaft **230** can be engaged with an end of screw **102** in a manner similar to the procedure discussed above. Once engaged, screw **102** can be driven by rotating shaft handle **234** in a driving direction. Alternatively, a power driving tool **300** can be coupled to an end of driving shaft **230** rather than requiring manual operation of the assembly. Once screw **102** is driven to a desired depth in workpiece **WP**, the procedure can be reversed to disengaged shaft **230** from screw **102**. Again, if the friction between sleeve **210** and driving shaft **230** (e.g., friction of contact at shaft handle **234**) is greater than the friction between screw **102** and workpiece **WP**, sleeve handle **214** can be held in place to prevent rotation of sleeve **210** while shaft handle **234** is rotated in reverse to disengage driver **202** from screw **102** without causing screw **102** to back out.

Conversely, if it is desired to remove screw **102** from work piece **WP**, sleeve handle **214** can be purposely rotated in a reverse direction. In addition, slide lock **216** can be moved to engage sleeve handle **214** to shaft handle **234**, and rotation of driving shaft **230** in a reverse direction (e.g., through operation of driving tool **300**) can cause reverse rotation of sleeve **210** to thereby remove screw **102** from work piece **WP**.

In either configuration, the operator can choose to leave first or second screwdriver assembly **201** or **202** connected to driving tool **300**. In this regard, with respect to second screwdriver assembly for example, connecting screw **102** to second screwdriver assembly **202** can comprise holding screw **102** up to first end **240** of driving shaft **230** and operating driving tool **300** in a forward direction to attach driving shaft **230** to screw **102**. Screw **102** can then be placed against workpiece **WP** and driven into place. Reversing the direction of driving tool **300** can disengage driving shaft **230** from screw **102**, allowing the operation to be repeated. To disengage a screw **102** that is solidly locked-on to driving shaft **230**, sleeve **210** can be held in place (e.g., by sleeve handle **214**) while driving tool **300** is operated in reverse. If the operator wishes to back out or remove screw **102**, with sleeve **210** solidly locked together to driving shaft **230**, such as by

"sandwiching" sleeve **210** between screw **102** and a portion of driving shaft **230** (e.g., shaft handle **234**) and/or by engaging slide lock **216**, driving tool **300** can be operated in reverse to back screw **102** out of work piece **WP**.

Regarding the features of pin **101** and screw **102** and of first and second screwdriver assemblies **201** and **202** that allow the components to be coupled together, a number of exemplary designs are shown in Figures 3 through 6B. It should be noted that Figures 3 through 6B illustrate various configurations for screw **102** having an integral head **110** and second screwdriver assembly **202**, but the principles discussed herein below with reference to these configurations can be equally applied to configurations of pin **101** and/or first screwdriver assembly **201**. In a first configuration shown in Figure 3, for example, a first screw **102a** can comprise a head **110** and a threaded body **120**. Head **110** can include one or more features intended to assist engagement of a screwdriver assembly, including but not limited to a threaded socket **112**, a textured head surface **114** (e.g., a serrated surface), and/or one or more slots **116**. Second screwdriver assembly **202** can be complementarily designed to interact with one or more of these engagement features. For example, a first screwdriver assembly arrangement, which is designated **202a** in Figure 4A, can be configured such that first end **240** of driving shaft **230** comprises a protruding tip **242** having a threaded outer surface **244**. Tip **242** can be sized and threaded outer surface **244** can be profiled to be complementary to the size and profile of threaded socket **112** of first screw **102a**. For example, tip **242** can extend beyond first end **220** of sleeve **210** by a distance **d** that can be less than a depth of corresponding threaded socket **112** on first screw **102a**. In this configuration, engagement of first screw **102a** can involve aligning tip **242** with threaded socket **112** and rotating driving shaft **230** such that threaded socket **112** enmeshes with threaded outer surface **244**, but tip **242** will be prevented from "bottoming" in threaded socket **112** and binding.

Those having ordinary skill in the art should recognize that threaded socket **112** of first screw **102a** (and similarly threaded outer surface **244** of driving shaft **230**) can be threaded in either a right-hand (i.e., clockwise tightening) or left-hand (i.e., counterclockwise tightening) direction

depending on the preference of the operator or considerations of the intended use. For example, if threaded socket **112** is designed to be right-hand threaded, operation of screwdriver assembly can be accomplished as described above, with both engagement of driving shaft **230** to first screw **102a** and driving of first screw **102a** being accomplished by rotating driving shaft **230** in the same direction (i.e., clockwise). In this orientation, backing first screw **102a** out of the work piece can be accomplished by rotating sleeve **210** in a counterclockwise direction.

Conversely, if threaded socket **112** is threaded in a left-hand direction, engagement of driving shaft **230** to first screw **102a** can be accomplished by rotating driving shaft **230** counterclockwise, but driving of first screw **102a** can accomplished by rotating sleeve **210** in a clockwise direction. In this configuration, first screw **102a** can be backed out of the work piece by rotating driving shaft **230** in a counterclockwise direction. In this way, since this direction is the same as the direction that can be used to tighten the connection between driving shaft **230** to first screw **102a**, more torque can be applied for the removal of first screw **102a** without risking disengagement of first screw **102a** from driving shaft **230**. In other words, when driving shaft **230** "bottoms" in threaded socket **112**, it can begin to extract first screw **102a**. Such a feature can be especially desirable in orthopedic surgery applications where removal of screws from a patient after the bone is healed can be difficult. In addition, if the threads of first screw **102a** within the bone are stripped (which is often the case), second screwdriver assembly **202** having first arrangement **202a** can still extract first screw **102a** by pulling it out, whereas current screwdrivers cannot "pull" a screw out of a hole in which it is stripped (i.e., they can only rotate to unscrew, but they are generally unable to apply tension to pull the screw out).

Alternatively, threaded socket **112** can be threaded in both directions simultaneously (i.e., the threads for both directions are present and cross one another). In this configuration, either a right-hand-threaded version or a left-hand-threaded version of driving shaft **230** can be used with first screw **102a** for different operations. Namely, a right-hand-threaded version of

driving shaft **230** can be used to drive first screw **102a** into a work piece, whereas a left-hand-threaded version can be used to extract first screw **102a** from the work piece.

Regarding additional engagement features, head **110** of first screw **102a** can comprise a textured head surface **114** that can enhance frictional coupling of head **110** to sleeve **210** when sleeve **210** is pressed against head **110** (e.g., because of force exerted by stop **232** or shaft handle **234**). In addition, as shown in Figure 4A, sleeve **210** can be similarly profiled to further enhance this interaction. Specifically, for example, sleeve **210** can have a first end **220**, which can define a textured sleeve surface **222** (e.g., a serrated surface). Textured sleeve surface **222** can be designed to interact with textured head surface **114** of head **110** of first screw **102a** such that when sleeve **210** is pressed against the end of first screw **102a** (e.g., against head **110**), the textured surfaces can act to increase the frictional force of this contact.

In this configuration, head **110** of first screw **102a** and first end **220** of sleeve **210** can fit together positively for rotation together. At least a roughened surface can be present on both for increasing frictional contact forces, but one or both components can be further modified to create a better fit. For example, textured head surface **114** and textured sleeve surface **222** can each comprise radially-arranged serrations that can interdigitate with one another. In this way, engaging driving shaft **230** tightly into socket **112** of first screw **102a** can cause such serrations to compress together, and thus turning sleeve **210** in reverse can act to readily back out first screw **102a**. The serrations can be sharply edged, or they can be rounded and/or undulating to prevent glove and tissue damage. Further, other configurations (e.g., a "saddle shape" profile for each surface) can likewise be incorporated to provide improved coupling in a similar manner.

Of course, it should be recognized that the surfaces of one or both of head **110** or sleeve **210** can be smooth, and second screwdriver assembly **202** can still operate to drive first screw **102a**. With smooth surfaces, however, it can be comparatively more difficult for sleeve **210** to cause rotation of first screw **102a**, such as to back first screw **102a** out for

repositioning. In such situations, the operator may need to switch to a different version of second screwdriver assembly **202** (e.g., left-hand-threaded version discussed above) to extract first screw **102a**, which can be considered an undesirable extra step.

Regarding yet another engagement feature, head **110** of first screw **102a** can comprise one or more slots **116** that can be used in a manner similar to the slots in conventional screws. For example, as shown in Figure 3, head **110** can comprise a single slot **116** positioned across a diameter of head **110**. To drive first screw **102a** having this configuration, a conventional screwdriver having a flat-bladed configuration can be used. Alternatively, a second screwdriver assembly arrangement, which is designated **202b** in Figure 4B, can be complementarily designed to interact with slots **116**. For example, as shown in Figure 4B, sleeve **210** can comprise one or more blades **224** that are spaced about first end **220** to correspond to the positions of slots **116** in head **110** of first screw **102a**. Specifically, to correspond to the single-slot design of first screw **102a** shown in Figure 3, sleeve **210** can comprise two blades **224** positioned opposing each other.

With this configuration, before or during engagement of tip **242** of driving shaft **230** with threaded socket **112** of first screw **102a**, blades **224** of sleeve **210** can be aligned with slot **116**. In this way, engagement of first screw **102a** can involve coupling of both driving shaft **230** and sleeve **210** to head **110** of first screw **102a**. As a result, a great degree of control can be exercised on first screw **102a**, which can help to obtain extremely secure fixation and easy removal of first screw **102a** to and from a work piece or bone. Further, as shown in Figure 4B, first end **220** of sleeve **210** can have a profile that tapers away from blades **224** to make it easier to insert blades **224** into slot **116** should any tissue be interposed.

In third screwdriver assembly arrangement, which is designated **202c** in Figure 4C, protruding tip **242** of driving shaft **230** of second screwdriver assembly **202** can comprise an unthreaded and smooth outer surface **246** (i.e., rather than threaded outer surface **244**). Using second screwdriver assembly **202** having third arrangement **202c**, rather than threading driving shaft **230** onto first screw**102a**, smooth outer surface **246** allows driving shaft

230 to slide into threaded socket **112** and serve to "center and align" driving shaft **230** on first screw **102a**. Such centering and alignment can be accomplished in comparatively less time than engaging the threaded version of driving shaft **230** to threaded socket **112** and can allow blades **224** to more easily and securely engage slot **116**. By comparison, using a traditional flat-blade screwdriver in a similar situation can often involve problems of the screwdriver sliding to one side in the slot, where it can damage the slot by twisting out of it, and/or operation of the driver when not fully aligned, which can tend to damage (i.e., "strip") the head of the screw. Furthermore, driving shaft **230** having a smooth outer surface **246** at tip **242** can snugly slide into the threaded socket **112**, which can allow the operator to "direct" the movement of first screw **102a**, thus enabling it to be "pointed" toward the hole in the other side of the work piece or bone.

Third arrangement **202c** can be used, for example, for tightening screws after initial insertion during bone surgery. It is frequently the case that, after placing all the screws, the later screws occasionally can deform the plate and bone towards one another, leaving the initial screws slightly loose. Thus, the surgeon can sometimes need to go back and hand-tighten all the screws at the end of the procedure. The surgeon may prefer not to go through the steps necessary to thread a driver onto the screw at that point, however, and would instead prefer the quick action of the driving head in Figure 4C.

Further regarding slots **116** and blades **224**, it can be recognized that similar to the many designs for conventional screw-screwdriver configurations that exist, a variety of different configurations for slots **116** and blades **224** can be implemented according to the present subject matter. For example, referring to Figures 5A and 5B, a second screw **102b** can comprise two slots **116** each extending across head **110** (e.g., perpendicular slots that intersect at a center of head **110**). A fourth screwdriver assembly arrangement, which is designated **202d** in Figure 5B, can be configured such that sleeve **210** can comprise four blades **224** spaced about first end **220** (e.g., equally distributed at 90 degree intervals). In this configuration,

the system can operate in a manner similar to any of a variety of cruciform-type screwdriver configurations.

Furthermore, fourth arrangement **202d** shown in Figure 5B provides examples of a number of additional modifications to the system that can be implemented. For example, the features of a textured engagement surface and slot-engaging blades can be implemented together. As shown in Figure 5B, first end **220** of sleeve **210** can comprise a plurality of blades **224** spaced apart from each other, and textured sleeve surface **222** can be provided on surfaces of first end **220** between blades **224**.

In addition, blades **224** can be formed with a non-uniform profile. Specifically, blades **224** can be tapered outward toward their outer edges, and second screw **102b** can be complementarily profiled such that slots **116** taper inwardly so that slots **116** each leave a constant amount of material at the lateral surface of the head**110**. One benefit of such a head design can be that whereas a complete slot can significantly weaken the screwhead such that the two "halves" of the screwhead (i.e., portions on either side of a given slot) might "split" apart if a blade screwdriver was turned against heavy resistance, a tapered slot can provide greater resistance against this kind of failure. Taking this principle a step further, maintaining a relatively thin "wall" around the perimeter of head **110** (not shown) can further strengthen head **110** against such phenomena and help with centering and alignment control over second screw **102b**. In addition, slot **116** can be made deeper without excessively weakening head **110**. Finally, such a configuration can help in manufacturing where tapping threads into a "blind hole" is difficult because there is no place for the swarf to go. A deep slot, cut before tapping the threads, would provide a relief zone for the swarf.

In yet a further alternative configuration, Figure 6A shows that a third screw **102c** can comprise a plurality of slots **116** arranged in a "double cruciform" pattern. In a fifth screwdriver assembly arrangement, which is designated **202e** in Figure 6B, sleeve **210** can correspondingly comprise eight blades **224** spaced about first end **220** of sleeve **210**. One advantage of these designs can be that the ridges between slots **116** can direct blades **224** so that they readily fall into engagement therein. Thus, the operator can

simply place second screwdriver assembly **202** on head **110** of third screw **102c**, spin it forward (e.g., using driving tool **300**), and blades **224** can interdigitate with slots **116** nearly as easily as they would grip radial serrations. In this regard, versions of second screwdriver assembly **202** having such multiple-blade configurations (e.g., fifth arrangement **202e**) can be used in much the same way as versions having only textured engagement surface (e.g., textured sleeve surface **222** in first arrangement **202a**), but the use of blades with slots can achieve a comparatively more positive fit, which can make it easier to unscrew third screw **102c** by turning sleeve **210** in reverse.

In surgery, bone screws can often be held in a "caddy." The actual step of picking the screws out of the caddy, however, is often clumsy in surgical gloves. Using screws and screwdriver assemblies according to the subject matter disclosed herein, this difficulty can be addressed since the driver can be placed on the screw head as it rests in the caddy and operated forward to attach the screw and ease the step of removing the screw from the caddy.

Similarly, in industrial applications where similar length screws are inserted repeatedly, as shown in Figure 7, a holder **400** (e.g., a clip/cartridge) can be used to hold multiple pins or screws (e.g., pin **101**, or any of the embodiments of screw **102**), which can be fed (e.g., by spring or gravity) into position behind an opening **410** (e.g., a cone-shaped guide). Use of holder **400** can allow the operator to slide a screwdriver assembly (e.g., first or second screwdriver assembly **201** or **202**) into opening **410** and onto head of one of the pins or screws, operate screwdriver assembly in a forward direction, and pull the pin or screw out of holder **400**. This process can be repeated for the sequential driving of multiple pins or screws.

The present subject matter can be embodied in other forms without departure from the spirit and essential characteristics thereof. The embodiments described therefore are to be considered in all respects as illustrative and not restrictive. Although the present subject matter has been described in terms of certain preferred embodiments, other embodiments that are apparent to those of ordinary skill in the art are also within the scope

of the present subject matter. For example, although first screwdriver assembly **201** and second screwdriver assembly **202** are discussed as being adapted for use with pin **101** and screw **102**, respectively, it should be understood that these or other configurations for a screwdriver assembly according to the presently disclosed subject matter can be adapted for use with any of a variety of fasteners, including but not limited to pin **101** and screw **102**. Specifically, for example, first screwdriver assembly **201** can be adapted for use with first screw **102a** or any of a variety of other fasteners having one or more of the features disclosed herein above. Similarly in this regard, although a variety of different arrangements for screws and screwdriver assemblies are shown and discussed herein, it should be recognized that further configurations having any combination of the features discussed are covered by the present subject matter.

CLAIMS

What is claimed is:

1. A screwdriver assembly comprising:

a hollow sleeve comprising a longitudinal bore and a first end defining a screw engagement surface; and

a driving shaft positioned within the longitudinal bore of the hollow sleeve and rotatable relative to the hollow sleeve, the driving shaft comprising:

a first end extending beyond the first end of the hollow sleeve, the first end comprising a protruding tip adapted for engaging a corresponding socket in a head of a screw;

a second end opposite the first end; and

a stop restricting axial movement of the sleeve towards the second end of the driving shaft.

2. The screwdriver assembly of claim 1, wherein the protruding tip extends beyond the first end of the hollow sleeve by a distance that is less than a depth of a corresponding socket on the screw.

3. The screwdriver assembly of claim 1, wherein the protruding tip comprises an externally-threaded outer surface adapted for engaging a corresponding threaded socket on the screw.

4. The screwdriver assembly of claim 1, wherein the screw engagement surface comprises a textured surface adapted to engage a textured surface of the head of the screw.

5. The screwdriver assembly of claim 1, wherein the screw engagement surface comprises one or more blades protruding from the first end and adapted to engage one or more corresponding slots in the head of the screw.

6. The screwdriver assembly of claim 5, wherein the one or more blades comprises two blades protruding from the first end on opposing sides of the protruding tip.

7. The screwdriver assembly of claim 5, wherein the one or more blades comprises four blades arranged in a cruciform pattern.

8. The screwdriver assembly of claim 1, comprising a lock movable to selectively link the hollow sleeve to the driving shaft for common rotation of the sleeve and the driving shaft.

9. A method for driving a screw comprising:

positioning a driving shaft within a longitudinal bore of a hollow sleeve, the driving shaft rotatable relative to the hollow sleeve;

connecting a screw to the driving shaft by engaging a protruding tip of the driving shaft with a corresponding socket in a head of the screw, wherein when the protruding tip is at least partially engaged with the socket of the screw, a first end of the hollow sleeve contacts the head of the screw;

rotating one or both of the driving shaft or the hollow sleeve in a first direction to advance the screw; and

rotating the driving shaft in a second direction opposite the first direction to disengage the protruding tip from the socket of the screw.

10. The method of claim 9, wherein connecting a screw to the driving shaft comprises engaging an externally-threaded surface of the protruding tip with a corresponding threaded surface of the socket.

11. The method of claim 9, wherein rotating one or both of the driving shaft or the hollow sleeve to advance the screw comprises connecting the driving shaft to a drill.

12. The method of claim 9, wherein rotating the driving shaft in the second direction to disengage the protruding tip from the socket of the screw

comprises preventing rotation of the hollow sleeve to prevent reverse rotation of the screw.

13. The method of claim 9, comprising engaging the first end of the hollow sleeve with the head of the screw once the protruding tip is at least partially engaged with the socket of the screw.

14. The method of claim 13, wherein engaging the first end of the hollow sleeve with the head of the screw comprises engaging a textured surface of the first end of the hollow sleeve with a textured surface of the head of the screw.

15. The method of claim 13, wherein engaging the first end of the hollow sleeve with the head of the screw further comprises engaging one or more blades protruding from the first end of the hollow sleeve with one or more corresponding slots in the head of the screw.

16. A fixation system comprising:

a screw comprising a threaded screw body and a screw head, the screw head comprising a socket and a screw head surface surrounding the socket; and

a screwdriver comprising:

a hollow sleeve comprising a longitudinal bore and a first end defining a screw engagement surface; and

a driving shaft positioned within the longitudinal bore of the hollow sleeve and rotatable relative to the hollow sleeve, the driving shaft comprising:

a first end extending beyond the first end of the hollow sleeve, the first end comprising a protruding tip adapted for engaging the socket of the screw head;

a second end opposite the first end; and

a stop restricting axial movement of the sleeve towards the second end of the driving shaft.

17. The fixation system of claim 16, wherein the screw head surface comprises a textured surface; and

wherein the screw engagement surface comprises a textured surface adapted to engage the textured surface of the screw head.

18. The fixation system of claim 16, wherein the screw head surface comprises one or more slots; and

wherein the screw engagement surface comprises one or more blades protruding from the first end and adapted to engage the one or more slots.

19. A screw comprising a threaded screw body adapted for engagement of a material and a screw head, the screw head comprising an internally-threaded socket adapted for engaging an externally-threaded driving shaft of a screwdriver.

20. The screw of claim 19, wherein the screw head comprises a textured surface adapted to engage a textured surface of the screwdriver.

21. The screw of claim 19, wherein the screw head comprises one or more slots in the surface of the screw head adapted to engage one or more corresponding blades in the screwdriver.

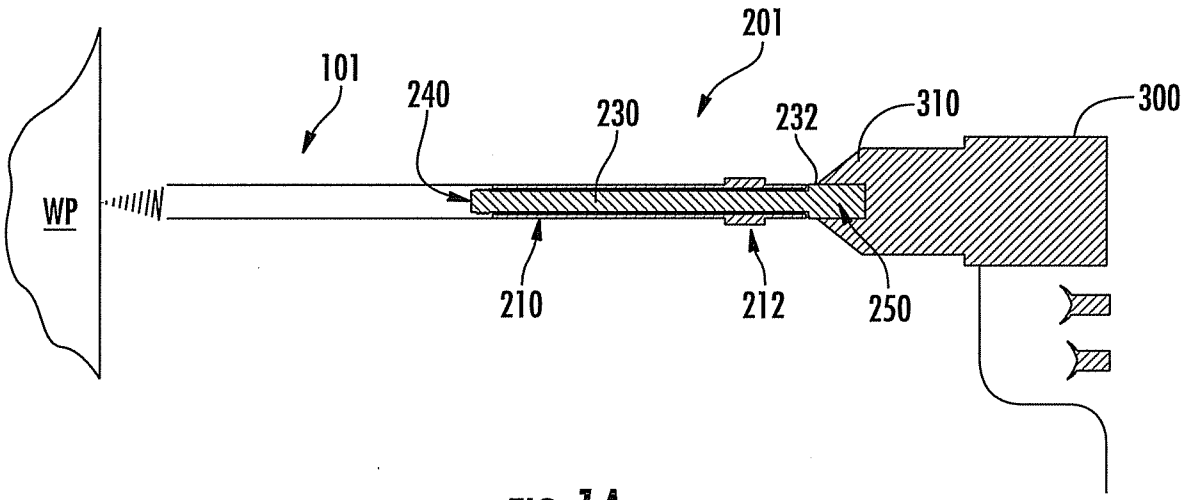
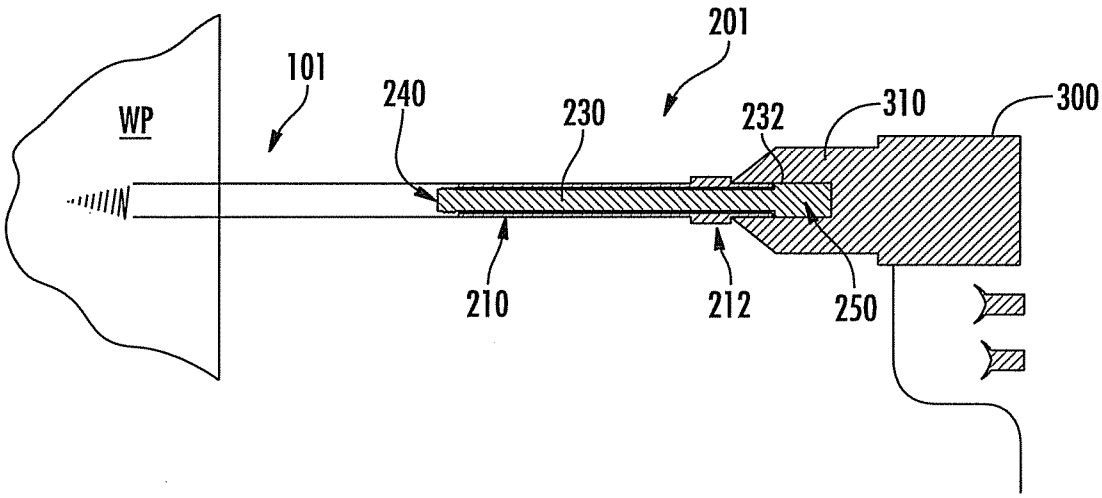

201
101
240
230
232
310
300
WP
210
212
250

FIG. 1A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232
310
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WP
210
212
250

FIG. 1B

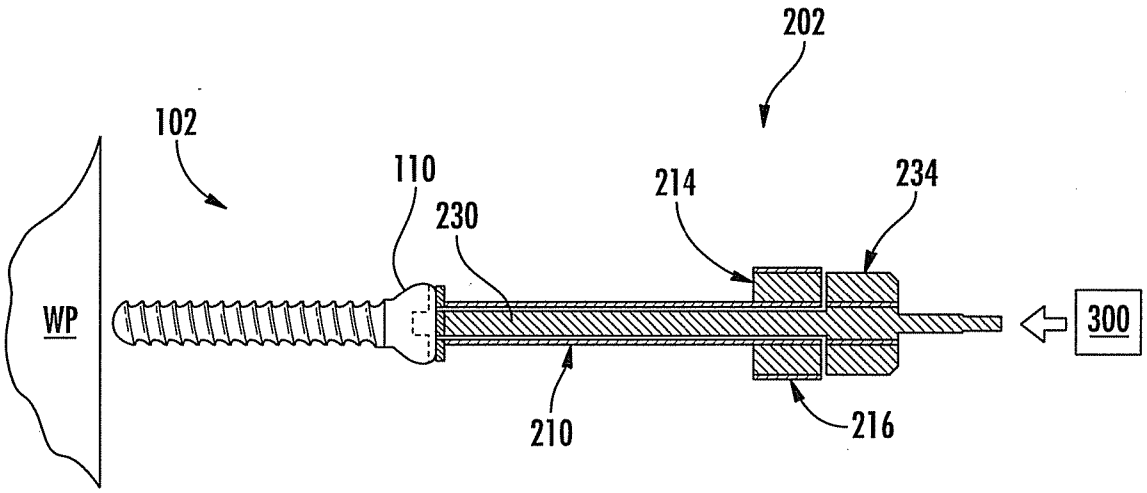
202
102
110
230
214
234
WP
300
210
216

FIG. 2A

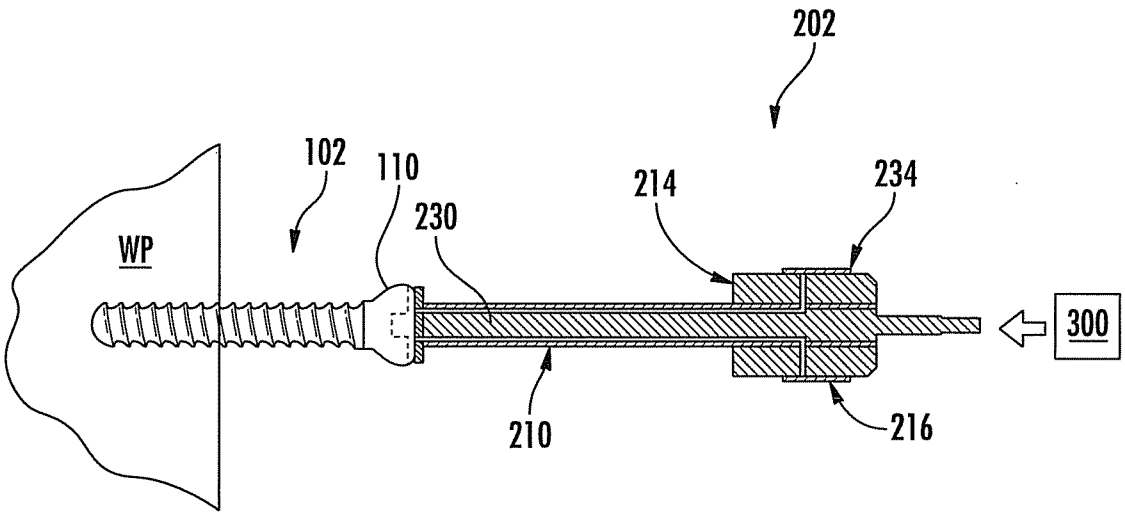
202
102
110
230
214
234
WP
300
210
216

FIG. 2B

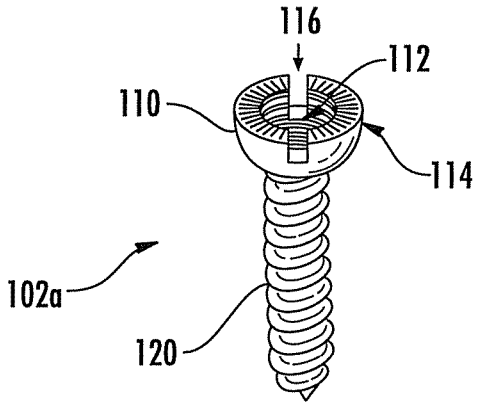

FIG. 3

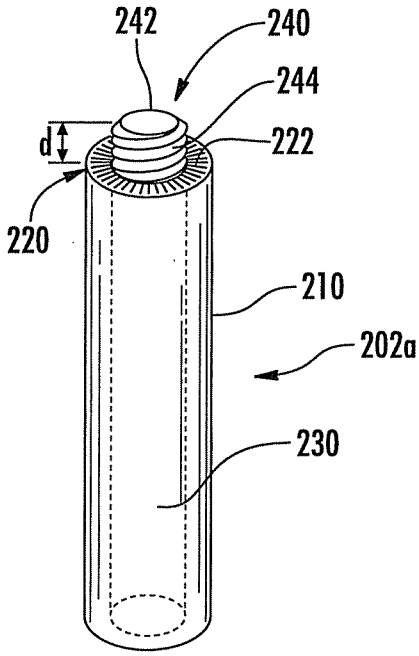

FIG. 4A

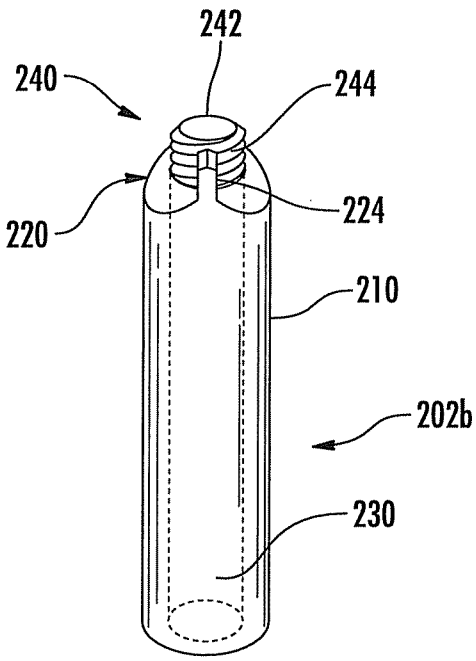

FIG. 4B

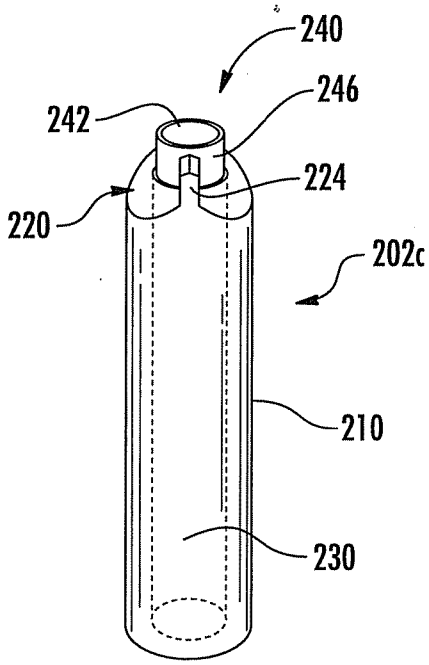

FIG. 4C

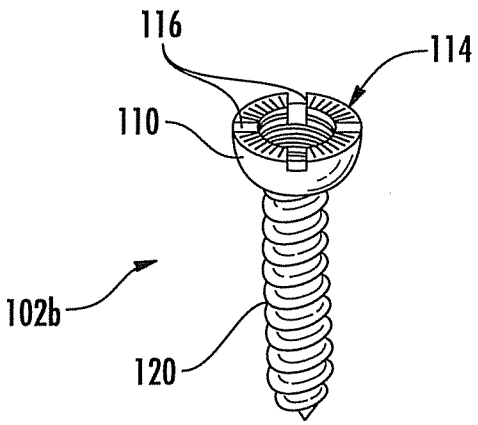

FIG. 5A

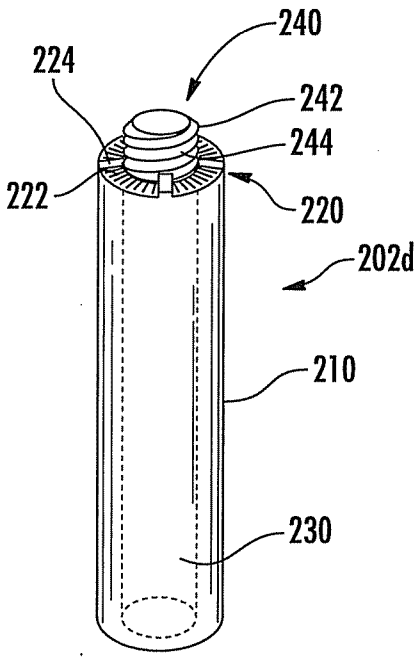

FIG. 5B

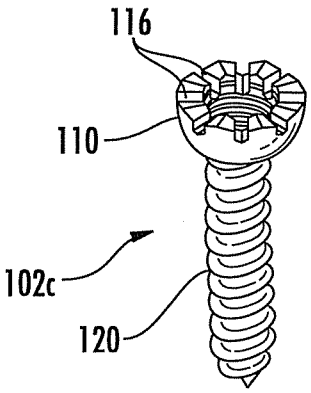

FIG. 6A

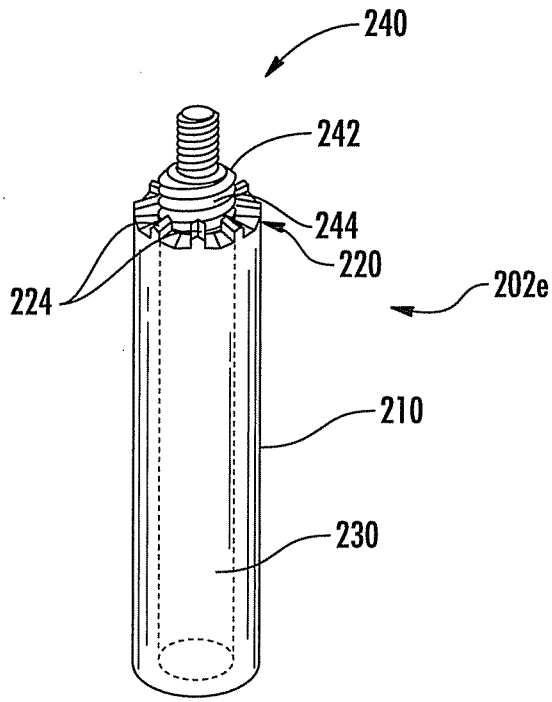

FIG. 6B

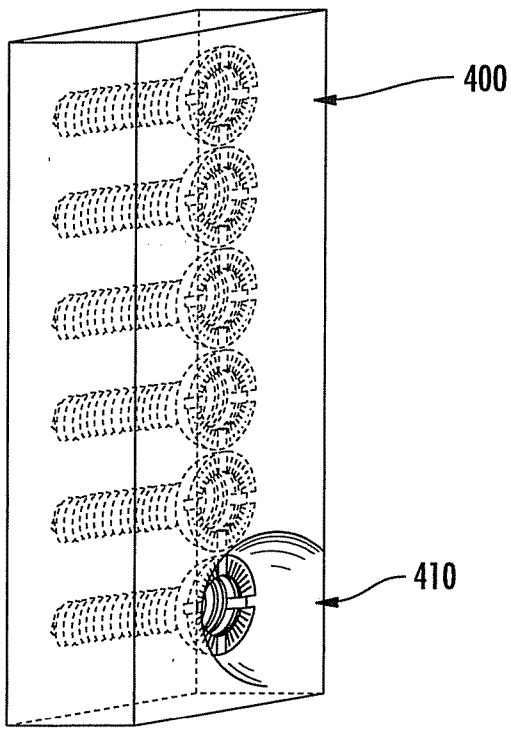

FIG. 7