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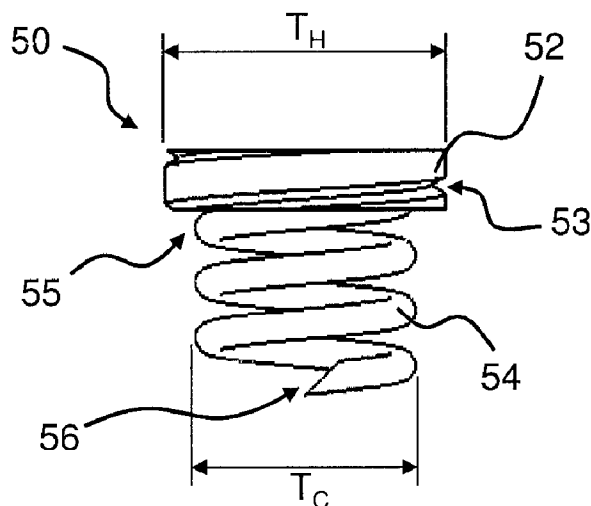
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(57) Abrégé/Abstract:

A surgical fastener deployment system may include a plurality of coil fasteners having a head and coil body. In one embodiment, the head may be larger in diameter than the coil body. The fasteners may also be mounted on a guide rod or mandrel that passes through a through-hole of the head and the coil body. The shaft may also include a guiding element that contacts and stabilizes the coil body as the fastener is deployed from a distal end of the shaft. When the head approaches and contacts the guiding element, the guiding element may deflect to permit the head to pass.

ABSTRACT

A surgical fastener deployment system may include a plurality of coil fasteners having a head and coil body. In one embodiment, the head may be larger in diameter than the coil body. The fasteners may also be mounted on a guide rod or mandrel that passes through a through-hole
5 of the head and the coil body. The shaft may also include a guiding element that contacts and stabilizes the coil body as the fastener is deployed from a distal end of the shaft. When the head approaches and contacts the guiding element, the guiding element may deflect to permit the head to pass.

METHODS AND APPARATUS FOR SURGICAL FASTENING**FIELD**

Aspects relate to methods and apparatus for surgical fastening.

BACKGROUND

5 Surgical fasteners are widely used in many different medical procedures. For example, staples, sutures, clips and other fasteners are commonly used in laparoscopic and open surgical procedures.

SUMMARY

 According to one embodiment, a surgical fastener deployment system includes
10 a first shaft including a proximal end and a distal end. The first shaft is configured to contain at least one coil fastener including a head attached to a coil body extending from the head. The surgical fastener deployment system also includes a guiding element constructed and arranged to guide the coil body of the at least one coil fastener and to deflect out of the path of the head of the at least one coil fastener as the at least one coil fastener is moved in a distal
15 direction.

 According to another embodiment, a method for deploying a surgical fastener includes: rotating and distally displacing a coil fastener within a first shaft in order to deploy the coil fastener, wherein the coil fastener comprises a head attached to a coil body extending from the head; contacting the coil body of the coil fastener with a guiding element during
20 deployment of the surgical fastener; and deflecting the guiding element out of the path of the head of the coil fastener during deployment of the coil fastener.

 According to another embodiment, there is provided a surgical fastener deployment system including: at least one coil fastener including a head attached to a coil body extending from the head, wherein the at least one coil fastener includes a distal most coil
25 fastener; a first shaft including a proximal end and a distal end, wherein the at least one coil fastener is disposed in the first shaft; and a guide associated with the first shaft, the guide

including at least one protruding surface that extends inwardly towards the coil body of the distal most coil fastener, wherein when a first portion of the coil body of the distal most coil fastener is located at and protrudes out from a distal most end of the surgical fastener deployment system the protruding surface of the guide engages a second portion of the coil body of the distal most coil fastener to guide the coil body of the distal most coil fastener as it is deployed from the distal most end of the surgical fastener deployment system, and wherein the protruding surface of the guide deflects out of a path of the head of the distal most coil fastener as the distal most coil fastener is moved in a distal direction.

According to another embodiment, there is provided a method of deploying a surgical fastener comprising: rotating and distally displacing a coil fastener within a first shaft in order to deploy the coil fastener, wherein the coil fastener comprises a head attached to a coil body extending from the head, wherein the first shaft includes a proximal end and a distal end; engaging the coil body of the coil fastener with at least one protruding surface of a guide during deployment of the surgical fastener from the distal end of the first shaft, the at least one protruding surface extending inwardly towards the coil body of the coil fastener, wherein when a first portion of the coil body is located at and protrudes out from the distal end of the first shaft the protruding surface contacts a second portion of the coil body to guide the coil body of the coil fastener; and deflecting the at least one protruding surface out of a path of the head of the coil fastener as the coil fastener is moved in a distal direction.

According to another embodiment, there is provided a surgical fastener deployment system including: at least one coil fastener including a head attached to a coil body extending from the head, wherein the at least one coil fastener includes a distal most coil fastener, wherein the head has a maximum transverse dimension larger than a maximum transverse dimension of the coil body; a first shaft including a proximal end and a distal end, wherein the at least one coil fastener is disposed in the first shaft; and a guide associated with the first shaft that engages the coil body of the distal most coil fastener to guide the coil body of the distal most coil fastener, wherein when a first portion of the coil body of the distal most coil fastener is located at and protrudes out from a distal most end of the surgical fastener deployment system the guide engages a second portion of the coil body to guide the coil body

of the distal most coil fastener as the distal most coil fastener is deployed from the distal most end of the surgical fastener deployment system, and wherein the guide deflects out of a path of the head of the distal most coil fastener as the distal most coil fastener is moved in a distal direction.

5 According to another embodiment, there is provided a surgical fastener deployment system including: at least one coil fastener including a head attached to a coil body extending from the head, wherein the at least one coil fastener includes a distal most coil fastener; a first shaft including a proximal end and a distal end, wherein the at least one coil fastener is disposed in the first shaft; and a guide associated with the first shaft, wherein when
10 a first portion of the coil body of the distal most coil fastener is located at and protrudes out from a distal most end of the surgical fastener deployment system the guide engages a second portion of the coil body of the distal most coil fastener to guide the coil body of the distal most coil fastener as the distal most coil fastener is deployed from the distal most end of the surgical fastener deployment system.

15 According to another embodiment, there is provided a surgical fastener deployment system including: at least one coil fastener including a head attached to a coil body extending from the head, wherein the at least one coil fastener includes a distal most coil fastener; a first shaft including a proximal end and a distal end, wherein the at least one coil fastener is disposed in the first shaft; and a protrusion associated with the first shaft that
20 extends inwardly towards the coil body of the distal most coil fastener, wherein when a first portion of the coil body of the distal most coil fastener is located at and protrudes out from a distal most end of the surgical fastener deployment system the protrusion engages a second portion of the coil body to guide the coil body of the distal most coil fastener as the distal most coil fastener is deployed from the distal most end of the surgical fastener deployment
25 system.

 According to another embodiment, there is provided a method of deploying a surgical fastener comprising: rotating and distally displacing a coil fastener within a first shaft of a surgical fastener deployment system to deploy the coil fastener from a distal most end of the surgical fastener deployment system, wherein the coil fastener comprises a head attached

to a coil body extending from the head; contacting the coil body of the coil fastener with a guiding element during deployment of the coil fastener when the coil fastener is located at and extends out of the distal most end of the surgical fastener deployment system; and deflecting the guiding element out of a path of the head of the coil fastener during deployment of the coil fastener.

According to another embodiment, there is provided a method of deploying a surgical fastener comprising: deploying a coil fastener, wherein the coil fastener comprises a head attached to a coil body extending from the head, and wherein the coil body includes a plurality of coil windings and a sharp distal tip; and guiding the coil body as the coil fastener is deployed to prevent at least one selected from the group of compression, radial expansion, and lateral deflection of the coil body.

According to another embodiment, there is provided a surgical fastener deployment system comprising: a first shaft including a proximal end and a distal end, wherein the first shaft is configured to include at least one coil fastener disposed in the first shaft, wherein the at least one coil fastener includes a head attached to a coil body extending from the head, and wherein the at least one coil fastener includes a distal most coil fastener; and a guide including a deflectable latch at least partially oriented in a distal direction, and wherein a distal end of the deflectable latch includes at least one protruding surface that extends inwardly toward the coil body of the distal most coil fastener, and wherein the deflectable latch is located within one fastener length of a distal most end of the surgical fastener deployment system.

According to another embodiment, there is provided a surgical fastener deployment system comprising: a first shaft including a proximal end and a distal end, wherein the first shaft is configured to include at least one coil fastener disposed in the first shaft, wherein the at least one coil fastener includes a head attached to a coil body extending from the head, and wherein the at least one coil fastener includes a distal most fastener; and a plurality of guides, wherein the plurality of guides are spaced around at least a portion of a circumference of the first shaft, wherein the plurality of guides are spaced along at least a portion of a length of the first shaft, wherein the plurality of guides are configured to guide the

coil body of the at least one coil fastener as the at least one coil fastener is moved in a distal direction, and wherein the plurality of guides are configured to deflect out of a path of the head of the at least one coil fastener as the at least one coil fastener is moved in a distal direction.

- 5 It should be appreciated that the foregoing concepts, and additional concepts discussed below, may be arranged in any suitable combination, as the present disclosure is not limited in this respect. Further, other advantages and novel features of the present disclosure will become apparent from the following detailed description of various non-limiting embodiments when considered in conjunction with the accompanying figures.

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BRIEF DESCRIPTION OF DRAWINGS

The accompanying drawings are not intended to be drawn to scale. In the drawings, each identical or nearly identical component that is illustrated in various figures may be represented by a like numeral. For purposes of clarity, not every component may be labeled in every drawing. Various embodiments of the invention will now be described, by way of example, with
5 reference to the accompanying drawings, in which:

FIG. 1 depicts a fastener deployment device that may be used to deploy surgical fasteners in accordance with an aspect of the invention;

10 FIG. 2A depicts a coil fastener with an enlarged head in accordance with an aspect of the invention;

FIG. 2B depicts a side view of the coil fastener of FIG. 2A;

FIG. 2C depicts a top view of the coil fastener of FIG. 2A;

FIG. 3A depicts a guide rod that may be used in the fastener deployment device of FIG. 1;

15 FIG. 3B depicts a cross-section of the guide rod of FIG. 3A;

FIG. 4A depicts a side view of a shaft including a guiding element that may be used in the fastener deployment device of FIG. 1 in accordance with an aspect of the invention;

FIG. 4B depicts a cross-sectional view of the shaft of FIG. 4A taken along the line B-B;

FIG. 4C depicts a perspective view of the shaft of FIG. 4A;

20 FIG. 4D depicts a top view of the shaft of FIG. 4A;

FIG. 5A depicts a fastener located at a distal opening of a shaft, the distal tip of the fastener contacting the distal tip of a deflectable latch;

FIG. 5B depicts the fastener of FIG. 5A exiting through the distal opening of the shaft;
and

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FIG. 5C depicts the latch of FIG. 5A deflecting out of the path of the head of the fastener as the head exits through the distal opening of the shaft.

DETAILED DESCRIPTION

5 The inventors have appreciated that conventional coil fasteners may be overdriven during deployment. In applications such as attachment of a prosthetic to tissue, overdriving a typical coil fastener may result in the coil fastener passing completely through the prosthetic and into the underlying tissue. As a result, the fastener is simply deployed into tissue without attaching the
10 fastener with an associated head having a transverse dimension, such as a diameter, larger than that of the coil body may help to increase visibility of the fastener and help to reduce the occurrence of overdriving of the fastener.

 Typically, coil fasteners without an associated head have uniform diameters along their lengths and are guided during deployment by an associated threaded shaft or mandrel that
15 engages with each of the coil windings of the coil fastener. In addition to guiding the coil fasteners during deployment, engaging the coil windings of the fastener may help to stabilize the coil fastener as it is deployed into a prosthetic and/or tissue. For example, stabilizing the coil fastener may help to prevent undesired compression of the fastener and ensure proper insertion into a target prosthetic and/or tissue by preventing axial deflection and/or radial expansion of the
20 coil fastener. However, in some embodiments, only the head of the fastener is guided and stabilized. Consequently, the coil windings of the surgical fastener may not be directly supported by the associated shaft or mandrel. Therefore, during deployment, as the distal end of the coil fastener is deployed into a target prosthetic and/or tissue, the coil body is left unsupported and free to compress, deflect laterally, and/or expand radially. As a result, the distal
25 end of the coil fastener may deflect laterally (e.g. to the side) and may enter the prosthetic and/or tissue at an angle and/or undesired position. The coil may also expand radially (e.g. the coil will expand to a larger diameter) and may enter the prosthetic and/or tissue in an unintended radial

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location. Alternatively, or in addition, the coil may compress against and/or skive across the tissue rather than penetrating into it, particularly when the coil encounters harder tissue such as bone.

In view of the above, the inventors have recognized the benefits associated with devices and methods capable of stabilizing a headed coil fastener as the fastener is deployed into a prosthetic and/or tissue. For example, in one specific embodiment, a guiding element such as a deflectable latch may be used to guide the coil body as the distal end of the fastener is deployed into tissue. Once the head of the fastener reaches the latch, the latch may deflect laterally to permit the head to pass.

For the sake of clarity, the embodiments depicted in the figures are directed to a laparoscopic device. However, the current disclosure is not limited to laparoscopic devices. Instead, the currently disclosed devices and methods could be used in any appropriate device for the deployment of a surgical fastener into tissue. For example, the surgical fasteners could be used in an endoscopic device, a borescopic device, a catheter, a deployment device for use in “open” procedures, or any other appropriate deployment device. Additionally, the surgical fasteners might be used individually, or a plurality of surgical fasteners could be used.

For the purposes of this application, a transverse dimension of the coil body or head generally refers to a dimension of the coil body or head within a plane that is perpendicular to a long axis of the surgical fastener when it is assembled (e.g. a diameter of a cylindrical coil body, a width of a rectangular head, the length of a side of a triangular coil body, etc...). For example, an outer transverse dimension of the coil body would refer to the lateral distance between opposing outer surfaces of the coil body and an inner transverse dimension of the coil body would refer to the lateral distance between opposing interior surfaces of the coil body. The outer transverse dimensions of the head T_H and coil body T_C in one embodiment are illustrated in Fig. 2B and correspond to the width of the head and the diameter of the coil body. It should be noted that in embodiments in which the head and/or the coil body are noncircular, the head and/or coil body may have both minimum and maximum transverse dimensions.

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FIG. 1 depicts an exemplary fastener deployment device 1 for deploying one or more surgical fasteners into a prosthetic and/or tissue. The deployment device includes a handle 4 at a proximal end of the device and an actuation button such as a trigger 2 on the handle. The deployment device also includes a shaft 10 extending in a distal direction from the handle 4. The shaft 10 has a proximal end 6 and a distal end 8. Actuating the trigger 2 deploys a distal-most surgical fastener from the distal end 8 of the shaft 10. Actuation of the trigger 2 may also advance one or more surgical fasteners towards the distal end of the shaft 10. It should be understood that the deployed surgical fastener may be deployed into any appropriate prosthetic, bone, and/or tissue. For example, in one embodiment, the prosthetic may be a soft tissue repair fabric, such as a surgical mesh, used for repairing a hernia.

FIGS. 2A-2C depict one embodiment of a coil fastener 50 including a head 52 attached to a distally extending coil body 54. More specifically, the coil body 54 has a proximal end 55 attached to the head 52 and a distal tip 56 adapted for insertion into a prosthetic and/or tissue. As depicted in the figure, the distal tip 56 may be sharp to facilitate penetration into an appropriate prosthetic, bone, and/or tissue. As shown in FIG. 2C, the head 52 may also include a through-hole 57 for accepting an associated guide rod or mandrel, as discussed in more detail below. The coil body 54 may be attached to the head 52 using any appropriate method. For example, the coil body 54 may be integral with the head 52 or it may be manufactured separately and attached using a compression fit, adhesives, mechanical interlocking features, threading, interference fits, or any other appropriate method.

In the depicted embodiment, and as best seen in FIG. 2B, the head 52 includes externally located threads 53 that engage with an associated threaded shaft as described below. The depicted head 52 has a maximum transverse dimension T_H (e.g. a diameter) that is greater than a maximum transverse dimension T_C of the coil body 54. The threads 53 on the head 52 may have a helix angle and/or pitch that is the same as the helix angle and/or pitch of the coil body 54. Alternatively, the threads 53 on the head 52 may have a helix angle and/or pitch that is different than the coil body 54 as the current disclosure is not limited in this fashion. While the depicted coil fastener includes a head with an external thread for engaging a threaded shaft or other

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appropriate component, in an alternative embodiment, the head may include an internal thread in the through-hole 57 for engaging a threaded mandrel or other appropriate component.

One embodiment of a guide rod is shown in FIGS. 3A-3B. One or more coil fasteners may be mounted to a guide rod 20 by passing the guide rod through the center of the coil body 54 and the through-hole 57 of the coil fastener head 52. FIG. 3B shows the cross-section 21 of the guide rod 20, which may be uniform throughout the length of the guide rod though other embodiments in which the cross-section is not uniform along the length of the guide rod are also possible. As depicted in the figure, the guide rod 20 is shaped and sized to pass through the through-hole 57 of the coil fastener head 52 to permit distal movement of the coil fasteners along the length of the guide rod. In some embodiments, as shown in FIGS. 2C and 3B, a shape and size of the cross-section 21 of the guide rod 20 may complement a shape and size of the through-hole 57 of the fastener head 52. Further, in some embodiments, the guide rod 20 is rotatable on actuation of the deployment device. As the guide rod 20 is rotated, the cross-section 21 of the guide rod applies a torque to the through-hole 57 of the fastener head and rotates the fastener. Therefore, the guide rod 20 may act as a rotatable drive shaft in addition to supporting the coil fasteners. As depicted in the figures, the guide rod may include one or more flats to prevent rotation of the guide 20 relative to the fasteners mounted thereon and facilitate the application of the above noted torque. However, while a particular shape is depicted in the figures, other shapes including triangles, quadrilaterals, ovals, asymmetrical shapes, and other appropriate shapes are possible.

In some embodiments, the fastener deployment device includes a shaft. In the embodiment shown in FIGS. 3-5, the guide rod 20 is sized to pass through the shaft 10. As best seen in FIG. 4B, the inner surface of the shaft 10 includes threads 12 that are sized and arranged to correspond with the external threads 53 on the coil fastener head 52. As described in more detail below, the fastener deployment device also includes one or more guiding elements that stabilize the coil portions of the surgical fasteners as they are deployed and/or displaced through the deployment device. The guiding element may be constructed and arranged to prevent lateral

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expansion and/or deflection of the coil body of the fastener while still being capable of deflecting, or moving, out of the path of the associated fastener head.

In the embodiment shown in FIGS. 4A-4D, the shaft 10 includes a guiding element in the form of a deflectable latch 14 that stabilizes the coil body of the fastener as it is deployed out of the deployment device. Without wishing to be bound by any theory, a coil fastener experiences a normal reaction force from the tissue, bone, and/or prosthetic as the fastener abuts against and/or penetrates it. Such a reaction force may cause the coil body 54 to compress axially, expand laterally outwards, and/or deflect laterally outwards. As mentioned previously, in some cases, without a suitable guiding element, the coil body may simply compress against and/or skive across the prosthetic, bone, and/or tissue rather than penetrating it when the coil is deployed. Without wishing to be bound by theory, the coil body may tend to expand laterally when compressed. The presence of the guiding element 14 may prevent the coil body 54 from compressing, expanding, and/or deflecting laterally outwards, or limit any of the foregoing, which may thereby stabilize the position of the coil body as it is deployed into a tissue and/or prosthetic. As a result, the presence of the guiding element 14 may constrain the coil body such that it moves distally and penetrates through prosthetic, bone, and/or tissue rather than compressing against or skiving across it.

In some embodiments, the guiding element is constructed and arranged such that it may be deflected, or is otherwise displaced, out the path of the head of the coil fastener. For example, as described in more detail below, the latch 14 depicted in the figures is capable of deflecting radially outwards when the transversely larger fastener head contacts the latch 14. Therefore, the latch 14 may have sufficient stiffness to resist deflection in response to the load applied by the coil body and yet flexible enough to deflect when the fastener head contacts the latch. The stiffness of the latch 14 may be controlled using any appropriate design consideration including, but not limited to, material selection, geometry, and orientation.

In the embodiment shown in FIGS. 4A-4D, the latch 14 is a cantilever beam. As shown in the figures, the latch 14 may have a width W , a thickness T , and a length L . Without wishing

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to be bound by any theory, the deflection distance of a cantilever beam is inversely proportional to the area moment of inertia of the beam, which is a function of thickness T and width W, and is proportional to the length L of the beam. Therefore, larger thicknesses T and widths W will result in larger area moment of inertias and correspondingly smaller deflections of the latch 14 in response to a particular applied force. Additionally, larger lengths L of the latch 14 will give rise to larger deflections of the latch 14 in response to a particular applied force. Consequently, one of skill in the art, may select various combinations of length, width, and thickness of the latch to obtain a desired bending stiffness. For example, the width W, thickness T, and length L may be chosen such that the guiding element deflects a very small or insignificant amount when subjected to forces by the coil body and deflects a larger amount when subjected to the larger forces from the fastener head. By appropriately selecting the stiffness to provide the above noted behavior, the latch 14 may be capable of both supporting the coil body during deployment and deflecting out of the way to accommodate the fastener head.

Depending on the embodiment, the latch 14 may have any appropriate width W, thickness T, and length L based on particular design considerations as the current disclosure is not so limited. However, in one embodiment the width W of the latch 14 may be between about 0.3 mm to 3 mm. The latch 14 may also have a thickness T of 0.1 to 1 mm, 0.2 to 0.9 mm, 0.3 to 0.8 mm, 0.3 to 0.7 mm, 0.4 to 0.6 mm, or 0.45 mm to 0.55 mm, inclusive. Additionally, the latch 14 may have a length L between about 5.5 mm to 9 mm, 6 mm to 8.5 mm, 6.5 mm to 8 mm, or 7 mm to 7.5 mm, inclusive.

In the embodiment shown in FIG. 4B, the deflectable latch 14 includes a distal tip 30. The distal tip 30 of the latch 14 extends and/or points inwardly toward the exiting fasteners in order to contact the coil body 54 of the fastener. As will be discussed in detail below, the tip of the latch 14 stabilizes the coil fasteners by remaining tangent to the coil body of the fasteners as the fasteners are deployed. However, in some embodiments, the latch may have a protruding surface that points inwardly toward the fasteners at a location other than the distal end of the latch. As non-limiting examples, the latch may have a protruding surface in the middle of the latch, at a distance that is three-quarters the length of the latch, or at any suitable location. In

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some embodiments, the latch may have multiple protruding surfaces along the length of the latch in order to support multiple coil windings within the coil body 54.

The latch 14 may be provided in any appropriate manner. For example, the latch 14 may be integrally formed with a shaft such that the shaft and the latch comprise a single monolithic component. In such an embodiment, the latch might be formed by forming slits in a shaft to form a cantilever using any suitable process. In other embodiments, the latch may be manufactured separately and attached to the shaft by an adhesive, a welding process, or any other suitable method or substance, as this aspect is not so limited.

Other configurations of a guiding element are also contemplated. For example, the guiding element might be embodied by a flexible element located in the interior of the shaft and extending radially inwards from the shaft inner surface such that it engages with and supports the coil windings of the coil fastener. The flexible element may then deflect out of the path of the head of the coil fastener similar to the above embodiment. The flexible element may be embodied as a flexible rod attached to, and extending radially inwards from, the inner surface of the shaft. In another alternative embodiment, the guiding element may be embodied by a camming surface positioned in the shaft and constructed and arranged to interact with both the coil body and the head. The camming surface may also be associated with a radially directed compressible spring that is either positioned within, or passes through, the shaft and applies a biasing force to the camming surface to bias it inwards towards the center of the shaft. Therefore, as the fastener head is displaced and contacts the camming surface, the camming surface may be cammed radially outwards compressing the associated spring and accommodating the passage of the fastener head. In view of the above, it should be understood that the guiding element may be constructed in any appropriate fashion such that it both guides the coil windings of the coil fastener during deployment and accommodates the passage of a head associated with the coil fastener.

It should also be appreciated that the guiding element is not limited to being located on the shaft 10. In some embodiments, the fastener deployment device may have a second outer

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shaft that surrounds the aforementioned shaft 10. Consequently, a guiding element may be located on the second outer shaft and may stabilize the fastener as discussed previously. In other embodiments, a guiding element may be included at the distal end of the guide rod.

The deployment of a fastener 50 using the shaft 10 and latch 14 of Figs. 4A-4D is shown in three different stages in FIGS. 5A-5C. FIG. 5A depicts a guide rod 20 disposed within the shaft 10. The coil fastener 50 is mounted on the guide rod 20, which passes through the through-hole of the fastener head 52 and coil body 54. The external threads 53 of the head 52 are engaged with the threads 12 on the inner surface of shaft 10. The coil fastener 50 is also located at the distal end of both the shaft 10 and guide rod 20 such that the distal tip 56 of the fastener 50 is at an opening of the shaft 10 and is in contact with the distal tip 30 of the latch 14. The distal tip 30 of the latch 14 may extend and/or point inwardly toward the exiting fasteners in order to contact the coil body 54 of the fastener. While a single coil fastener 50 has been depicted for the sake of clarity, any number of coil fasteners could be held within shaft 10. Further, as noted above, while a latch 14 has been depicted for the guiding element, any suitable guiding element may be used.

As shown in FIG. 5B, when the fastener 50 is rotated and moved in the distal direction relative to the shaft 10 and associated latch 14, the tip 30 of latch 14 remains tangent to and guides the coil body 54 as it rotates against and slides past the latch tip 30. In the embodiment shown in the figures, the latch tip 30 is angled to correspond to the helix angle of the coil body 54. Such an angle on the latch tip 30 may help the latch tip 30 to remain tangent to the coil body 54 as the coil fastener is deployed. In other embodiments, the latch tip 30 may be flat or have an angle that differs from the helix angle of the coil body 54.

Finally, as shown in FIG. 5C, when the fastener head 52 approaches the latch tip 30, the head 52 applies a force to the tip 30 of the latch 14. In the depicted embodiment, the latch tip 30 acts as a camming surface such that contact between the fastener head 52 and the latch tip 30 during distal movement of the coil fastener causes the latch 14 to deflect outwards in a radial direction. Correspondingly, the force applied to the latch tip 30 during actuation deflects the

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latch 14 outwardly in a radial direction until it is out of the path of the head 52 and the fastener head 52 is able to be displaced in the distal direction.

As noted above, the functions of the guide rod and shaft may be reversed such that the shaft, or any other appropriate component, may be rotated to deploy the fasteners while the guide rod remains stationary. In such an arrangement, the guide rod may have a circular cross-sectional shape and may include threads. Correspondingly, the fastener head through-hole may be circular with internal threads that engage with the guide rod threads. Further, in such an embodiment, the fastener head may have a non-circular shape corresponding to a shape and size of the internal passage of the associated shaft. In such an embodiment, a guiding element may be located on the guide rod. However, the guiding element may also be located on the shaft and/or on another component such as a stationary second outer shaft that surrounds the aforementioned shaft.

While a single guiding element for guiding the coil fasteners has been depicted in the figures, a plurality of guiding elements for guiding the coil fasteners also is contemplated. For example, a plurality of latches or other guiding elements could be provided along a length of the deployment device to aid in guiding coil fasteners as they are distally moved through the shaft. Alternatively, or in addition to the above, a plurality of latches or other guiding elements could be associated with a coil fastener located in the distal most deployment position. In such an embodiment, the plurality of latches or other guiding elements at the end of the shaft may be radially spaced around the circumference of the shaft. The individual latches or other guiding elements may also be set at slightly different positions along the length of the shaft such that the latch tips engage with corresponding individual coil windings of the coil body of the distal most coil fastener. For example, a first latch could be located at the distal outlet of the shaft to guide the coil fastener as it is deployed into tissue and a second latch could be located half a coil fastener length up from the first latch to further stabilize the coil fastener during deployment. It should be understood that other arrangements are also possible.

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The shaft may be made from aluminum, stainless steel, nickel alloys, titanium alloys, nickel titanium alloys, or any other suitable material, as this aspect is not so limited. The coil body of the fastener may be made from stainless steel, nickel titanium based alloys such as nitinol, titanium alloys, biocompatible and/or bioresorbable metals and bioresorbable polymers, or any other suitable material, as this aspect is not so limited. The guide rod may be made from stainless steel, a polymer, nickel alloys, titanium alloys, nickel titanium alloys, or any other suitable material. In some embodiments, if the latch or other guiding element is included on a shaft, the latch or other guiding element may be made of the same material as that of the shaft. However, in instances where the latch or other guiding element is made separately from the component it is assembled with, the latch or other guiding element may be made from aluminum, stainless steel, nickel titanium based alloys such as nitinol, titanium alloys, nickel alloys, polymers, or any other suitable material, as this aspect is not so limited.

The above aspects and embodiments may be employed in any suitable combination, as the present invention is not limited in this respect.

Having thus described several aspects of at least one embodiment of this invention, it is to be appreciated that various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications, and improvements are intended to be part of this disclosure, and are intended to be within the scope of the invention. Accordingly, the foregoing description and drawings are by way of example only.

What is claimed is:

CLAIMS:

1. A surgical fastener deployment system including:

at least one coil fastener including a head attached to a coil body extending from the head, wherein the at least one coil fastener includes a distal most coil fastener;

5 a first shaft including a proximal end and a distal end, wherein the at least one coil fastener is disposed in the first shaft; and

a guide associated with the first shaft, the guide including at least one protruding surface that extends inwardly towards the coil body of the distal most coil fastener, wherein when a first portion of the coil body of the distal most coil fastener is located at and
10 protrudes out from a distal most end of the surgical fastener deployment system the protruding surface of the guide engages a second portion of the coil body of the distal most coil fastener to guide the coil body of the distal most coil fastener as it is deployed from the distal most end of the surgical fastener deployment system, and wherein the protruding surface of the guide deflects out of a path of the head of the distal most coil fastener as the distal most coil fastener
15 is moved in a distal direction.

2. The surgical fastener deployment system of claim 1, wherein the head has a maximum transverse dimension larger than a maximum transverse dimension of the coil body.

3. The surgical fastener deployment system of claim 2, wherein the head of the at least one coil fastener includes external threads.

20 4. The surgical fastener deployment system of claim 3, wherein the first shaft includes internal threads that engage with the external threads of the head of the at least one coil fastener.

5. The surgical fastener deployment system of claim 4, wherein a helix angle of the external threads of the head are equal to a helix angle of the coil body.

25 6. The surgical fastener deployment system of claim 1, further comprising a guide rod positioned inside the first shaft, wherein the guide rod supports the at least one coil

fastener, and wherein rotation of the guide rod causes the at least one coil fastener to rotate and move towards the distal end of the first shaft.

7. The surgical fastener deployment system of claim 1, wherein rotation of the first shaft causes the at least one coil fastener to rotate and move towards the distal end of the first shaft.
8. The surgical fastener deployment system of claim 1, wherein a distal tip of the guide is located at the distal end of the first shaft.
9. The surgical fastener deployment system of claim 1, wherein a second inner shaft is positioned between the first shaft and a guide rod positioned inside the first shaft.
10. The surgical fastener deployment system of claim 1, wherein at least a portion of the guide contacts the coil body of the distal most coil fastener as the distal most coil fastener moves in the distal direction, and contact between the guide and the head of the distal most coil fastener causes the guide to deflect away from the head of the distal most coil fastener.
11. The surgical fastener deployment system of claim 1, wherein the guide comprises a deflectable latch.
12. The surgical fastener deployment system of claim 11, wherein the latch has a length of 5.5 mm to 9 mm.
13. The surgical fastener deployment system of claim 11, wherein the latch has a thickness of 0.1 mm to 1 mm.
14. The surgical fastener deployment system of claim 11, wherein the latch has a width of 0.3 mm to 3 mm.
15. The surgical fastener deployment system of claim 11, wherein the latch is integrally formed with the shaft such that the shaft and the latch comprise a single monolithic component.

16. The surgical fastener deployment system of claim 11, wherein the latch comprises a cantilever.

17. The surgical fastener deployment system of claim 1, wherein the at least one protruding surface is located at a distal end of the guide.

5 18. The surgical fastener deployment system of claim 1, further comprising a guide rod positioned inside the first shaft, wherein the guide rod is located entirely within the first shaft.

19. The surgical fastener deployment system of claim 1, wherein the protruding surface of the guide contacts the head of the at least one coil fastener as the distal most coil
10 fastener is deployed from the distal most end of the surgical fastener deployment system.

20. The surgical fastener deployment system of claim 1, wherein the distal most end of the surgical fastener deployment system is constructed and arranged to contact at least one of tissue and a prosthesis during operation.

21. A method of deploying a surgical fastener comprising:

15 rotating and distally displacing a coil fastener within a first shaft in order to deploy the coil fastener, wherein the coil fastener comprises a head attached to a coil body extending from the head, wherein the first shaft includes a proximal end and a distal end;

engaging the coil body of the coil fastener with at least one protruding surface of a guide during deployment of the surgical fastener from the distal end of the first shaft, the
20 at least one protruding surface extending inwardly towards the coil body of the coil fastener, wherein when a first portion of the coil body is located at and protrudes out from the distal end of the first shaft the protruding surface contacts a second portion of the coil body to guide the coil body of the coil fastener; and

deflecting the at least one protruding surface out of a path of the head of the
25 coil fastener as the coil fastener is moved in a distal direction.

22. The method of claim 21, wherein rotation of a guide rod causes the coil fastener to rotate and distally displace within the first shaft.

23. The method of claim 21, wherein the guide guides the coil fastener.

24. The method of claim 23, wherein the guide is located at the distal end of the
5 first shaft.

25. The method of claim 21, wherein the protruding surface deflects out of the path of the head of the coil fastener when a latch contacts the head.

26. A surgical fastener deployment system including:

at least one coil fastener including a head attached to a coil body extending
10 from the head, wherein the at least one coil fastener includes a distal most coil fastener, wherein the head has a maximum transverse dimension larger than a maximum transverse dimension of the coil body;

a first shaft including a proximal end and a distal end, wherein the at least one coil fastener is disposed in the first shaft; and

15 a guide associated with the first shaft that engages the coil body of the distal most coil fastener to guide the coil body of the distal most coil fastener, wherein when a first portion of the coil body of the distal most coil fastener is located at and protrudes out from a distal most end of the surgical fastener deployment system the guide engages a second portion of the coil body to guide the coil body of the distal most coil
20 fastener is deployed from the distal most end of the surgical fastener deployment system, and wherein the guide deflects out of a path of the head of the distal most coil fastener as the distal most coil fastener is moved in a distal direction.

27. The surgical fastener deployment system of claim 26, wherein the head of the at least one coil fastener includes external threads.

28. The surgical fastener deployment system of claim 27, wherein the first shaft includes internal threads that engage with the external threads of the head of the at least one coil fastener.

29. The surgical fastener deployment system of claim 28, wherein a helix angle of the external threads of the head are equal to a helix angle of the coil body.

30. The surgical fastener deployment system of claim 26, further comprising a guide rod positioned inside the first shaft, wherein the guide rod supports the at least one coil fastener, and wherein rotation of the guide rod causes the at least one coil fastener to rotate and move towards the distal end of the first shaft.

31. The surgical fastener deployment system of claim 26, wherein rotation of the first shaft causes the at least one coil fastener to rotate and move towards the distal end of the first shaft.

32. The surgical fastener deployment system of claim 26, wherein a distal tip of the guide is located at the distal end of the first shaft.

33. The surgical fastener deployment system of claim 26, wherein a second inner shaft is positioned between the first shaft and a guide rod positioned inside the first shaft.

34. The surgical fastener deployment system of claim 26, wherein at least a portion of the guide contacts the coil body as the coil fastener moves in a distal direction, and contact between the guide and the head causes the guide to deflect away from the head.

35. The surgical fastener deployment system of claim 26, wherein the guide comprises a deflectable latch.

36. The surgical fastener deployment system of claim 35, wherein the latch is integrally formed with the first shaft such that the first shaft and the latch comprise a single monolithic component.

37. The surgical fastener deployment system of claim 35, wherein the latch comprises a cantilever.

38. The surgical fastener deployment system of claim 26, further comprising a guide rod positioned inside the first shaft, wherein the guide rod is located entirely within the first shaft.

39. The surgical fastener deployment system of claim 26, wherein a protruding surface of the guide contacts the head of the distal most coil fastener as the distal most coil fastener is deployed from the distal most end of the surgical fastener deployment system.

40. The surgical fastener deployment system of claim 26, wherein the distal most end of the surgical fastener deployment system is constructed and arranged to contact at least one of tissue and a prosthesis during operation.

41. A surgical fastener deployment system including:

at least one coil fastener including a head attached to a coil body extending from the head, wherein the at least one coil fastener includes a distal most coil fastener;

a first shaft including a proximal end and a distal end, wherein the at least one coil fastener is disposed in the first shaft; and

a guide associated with the first shaft, wherein when a first portion of the coil body of the distal most coil fastener is located at and protrudes out from a distal most end of the surgical fastener deployment system the guide engages a second portion of the coil body of the distal most coil fastener to guide the coil body of the distal most coil fastener as the distal most coil fastener is deployed from the distal most end of the surgical fastener deployment system.

42. The surgical fastener deployment system of claim 41, wherein the guide deflects out of the path of the head of the distal most coil fastener as the distal most coil fastener is moved in a distal direction.

43. The surgical fastener deployment system of claim 41, wherein the head of the at least one coil fastener has a maximum transverse dimension larger than a maximum transverse dimension of the coil body.

44. The surgical fastener deployment system of claim 43, wherein the head of the at least one coil fastener includes external threads.

45. The surgical fastener deployment system of claim 44, wherein the first shaft includes internal threads that engage with the external threads of the head of the at least one
5 coil fastener.

46. The surgical fastener deployment system of claim 45, wherein a helix angle of the external threads of the head are equal to a helix angle of the coil body.

47. The surgical fastener deployment system of claim 41, further comprising a guide rod positioned inside the first shaft, wherein the guide rod supports the at least one coil
10 fastener, and wherein rotation of the guide rod causes the distal most coil fastener to rotate and move towards the distal most end of the surgical fastener deployment system.

48. The surgical fastener deployment system of claim 41, wherein rotation of the first shaft causes the distal most coil fastener to rotate and move towards the distal most end of the surgical fastener deployment system.

15 49. The surgical fastener deployment system of claim 41, wherein a distal tip of the guide is located at the distal most end of the surgical fastener deployment system.

50. The surgical fastener deployment system of claim 41, wherein a second inner shaft is positioned between the first shaft and a guide rod positioned inside the first shaft.

51. The surgical fastener deployment system of claim 41, wherein at least a portion
20 of the guide contacts the coil body of the distal most coil fastener as the distal most coil fastener moves in the distal direction, and contact between the guide and the head of the distal most coil fastener causes the guide to deflect away from the head of the distal most coil fastener.

52. The surgical fastener deployment system of claim 41, wherein the guide
25 comprises a deflectable latch.

53. The surgical fastener deployment system of claim 52, wherein the latch has a length of 5.5 mm to 9 mm.

54. The surgical fastener deployment system of claim 52, wherein the latch has a thickness of 0.1 mm to 1 mm.

5 55. The surgical fastener deployment system of claim 52, wherein the latch has a width of 0.3mm to 3 mm.

56. The surgical fastener deployment system of claim 52, wherein the latch is integrally formed with the first shaft such that the first shaft and the latch comprise a single monolithic component.

10 57. The surgical fastener deployment system of claim 52, wherein the latch comprises a cantilever.

58. The surgical fastener deployment system of claim 41, wherein the guide includes at least one protruding surface located at a distal end of the guide.

59. The surgical fastener deployment system of claim 41, wherein the first shaft is
15 an outermost shaft of the surgical fastener deployment system.

60. The surgical fastener deployment system of claim 59, further comprising a guide rod positioned inside the first shaft, wherein the guide rod is located entirely within the first shaft.

61. The surgical fastener deployment system of claim 59, wherein a protruding
20 surface of the guide contacts the head of the distal most coil fastener as the distal most coil fastener is deployed from the distal most end of the surgical fastener deployment system.

62. The surgical fastener deployment system of claim 59, wherein the distal most end of the surgical fastener deployment system is constructed and arranged to contact at least one of tissue and a prosthesis during operation.

63. A surgical fastener deployment system including:

at least one coil fastener including a head attached to a coil body extending from the head, wherein the at least one coil fastener includes a distal most coil fastener;

5 a first shaft including a proximal end and a distal end, wherein the at least one coil fastener is disposed in the first shaft; and

a protrusion associated with the first shaft that extends inwardly towards the coil body of the distal most coil fastener, wherein when a first portion of the coil body of the distal most coil fastener is located at and protrudes out from a distal most end of the surgical fastener deployment system the protrusion engages a second portion of the coil body to guide
10 the coil body of the distal most coil fastener as the distal most coil fastener is deployed from the distal most end of the surgical fastener deployment system.

64. The surgical fastener deployment system of claim 63, wherein the protrusion is displaced out of the path of the head of the distal most coil fastener as the distal most coil fastener is moved in a distal direction.

15 65. The surgical fastener deployment system of claim 63, wherein the head of the at least one coil fastener includes external threads.

66. The surgical fastener deployment system of claim 65, wherein the first shaft includes internal threads that engage with the external threads of the head of the at least one coil fastener.

20 67. The surgical fastener deployment system of claim 66, wherein a helix angle of the external threads of the head are equal to a helix angle of the coil body.

68. The surgical fastener deployment system of claim 63, further comprising a guide rod positioned inside the first shaft, wherein the guide rod supports the at least one coil fastener, and wherein rotation of the guide rod causes the at least one coil fastener to rotate
25 and move towards the distal most end of the surgical fastener deployment system.

69. The surgical fastener deployment system of claim 63, wherein rotation of the first shaft causes the at least one coil fasteners to rotate and move towards the distal most end of the surgical fastener deployment system.

70. The surgical fastener deployment system of claim 63, wherein a distal tip of the protrusion is located at the distal most end of the surgical fastener deployment system.

71. The surgical fastener deployment system of claim 63, wherein a second inner shaft is positioned between the first shaft and a guide rod positioned inside the first shaft.

72. The surgical fastener deployment system of claim 63, wherein at least a portion of the protrusion contacts the coil body as the at least one coil fastener moves in the distal direction, and contact between the protrusion and the head causes the protrusion to deflect away from the head.

73. The surgical fastener deployment system of claim 63, wherein the protrusion comprises a deflectable latch.

74. The surgical fastener deployment system of claim 73, wherein the latch is integrally formed with the first shaft such that the first shaft and the latch comprise a single monolithic component.

75. The surgical fastener deployment system of claim 73, wherein the latch comprises a cantilever.

76. The surgical fastener deployment system of claim 63, wherein the first shaft is an outermost shaft.

77. The surgical fastener deployment system of claim 63, further comprising a guide rod positioned inside the first shaft, wherein the guide rod is located entirely within the first shaft.

78. The surgical fastener deployment system of claim 63, wherein the protrusion contacts the head of the distal most coil fastener as the distal most coil fastener is deployed from the distal most end of the surgical fastener deployment system.

79. The surgical fastener deployment system of claim 63, wherein the distal most end of the surgical fastener deployment system is constructed and arranged to contact at least one of tissue and a prosthesis during operation.

80. A method of deploying a surgical fastener comprising:

5 rotating and distally displacing a coil fastener within a first shaft of a surgical fastener deployment system to deploy the coil fastener from a distal most end of the surgical fastener deployment system, wherein the coil fastener comprises a head attached to a coil body extending from the head;

10 contacting the coil body of the coil fastener with a guiding element during deployment of the coil fastener when the coil fastener is located at and extends out of the distal most end of the surgical fastener deployment system; and

deflecting the guiding element out of a path of the head of the coil fastener during deployment of the coil fastener.

15 81. The method of claim 80, wherein the guide prevents at least one selected from the group of compression, radial expansion, and lateral deflection of the coil body as the coil fastener is deployed from the distal most end of the surgical fastener deployment system.

82. The method of claim 80, wherein the coil body includes a plurality of coil windings, and wherein the coil windings include interior opposing surfaces disposed on opposite sides of a long axis of the coil fastener.

20 83. The method of claim 80, wherein rotating and distally displacing the coil fastener within the first shaft comprises rotating a rod to rotate and distally displace the coil fastener.

84. The method of claim 80, wherein the guiding element guides the coil fastener as the coil fastener is deployed.

25 85. The method of claim 84, wherein the guiding element is located at a distal end of the first shaft.

86. The method of claim 84, wherein the guiding element guides the coil body of the coil fastener when the guiding element contacts the coil body.

87. The method of claim 80, wherein the guiding element deflects out of a path of the head of the coil fastener when the guiding element contacts the head.

5 88. A method of deploying a surgical fastener comprising:

deploying a coil fastener, wherein the coil fastener comprises a head attached to a coil body extending from the head, and wherein the coil body includes a plurality of coil windings and a sharp distal tip; and

10 guiding the coil body as the coil fastener is deployed to prevent at least one selected from the group of compression, radial expansion, and lateral deflection of the coil body.

89. The method of claim 88, wherein guiding the coil body as the coil fastener is deployed comprises guiding the coil body as the coil fastener is extending out from a distal most end of a surgical fastener deployment system.

15 90. The method of claim 89, wherein guiding the coil body as the coil fastener is extending out from the distal most end of the surgical fastener deployment system comprises contacting at least one of the coil windings with a guide.

91. The method of claim 90, further comprising deflecting the guide out of a path of a head of the coil fastener.

20 92. The method of claim 88, wherein deploying the coil fastener comprises rotating and distally displacing the coil fastener as the coil fastener is deployed.

93. The method of claim 92, wherein rotating and distally displacing the coil fastener comprises rotating a rod to rotate and distally displace the coil fastener.

25 94. The method of claim 93, wherein the rod is positioned in a through hole formed in the head of the coil fastener.

95. The method of claim 88, further comprising engaging external threads of the head of the coil fastener with internal threads of a first shaft.

96. The method of claim 95, further comprising rotating the first shaft to rotate and move the coil fastener towards a distal end of the first shaft.

5 97. The method of claim 88, wherein the coil windings include interior opposing surfaces disposed on opposite sides of a long axis of the coil fastener.

98. A surgical fastener deployment system comprising:

a first shaft including a proximal end and a distal end, wherein the first shaft is configured to include at least one coil fastener disposed in the first shaft, wherein the at least
10 one coil fastener includes a head attached to a coil body extending from the head, and wherein the at least one coil fastener includes a distal most coil fastener; and

a guide including a deflectable latch at least partially oriented in a distal direction, and wherein a distal end of the deflectable latch includes at least one protruding surface that extends inwardly toward the coil body of the distal most coil fastener, and
15 wherein the deflectable latch is located within one fastener length of a distal most end of the surgical fastener deployment system.

99. The surgical fastener deployment system of claim 98, further comprising the at least one coil fastener.

100. The surgical fastener deployment system of claim 98, wherein the deflectable
20 latch comprises a cantilever.

101. The surgical fastener deployment system of claim 98, wherein the deflectable latch is integrally formed with the first shaft such that the first shaft and the deflectable latch comprise a single monolithic component.

102. The surgical fastener deployment system of claim 98, wherein the deflectable
25 latch is formed by two slits in the first shaft along the distal length.

103. The surgical fastener deployment system of claim 98, wherein the deflectable latch is formed separately from the first shaft.

104. The surgical fastener deployment system of claim 98, wherein the guide is configured to prevent at least one selected from the group of compression, radial expansion, and lateral deflection of the coil body as the coil fastener is deployed from the distal most end of the surgical fastener deployment system.

105. The surgical fastener deployment system of claim 99, wherein the coil body includes a plurality of coil windings, and wherein the coil windings include interior opposing surfaces disposed on opposite sides of a long axis of the coil fastener.

106. The surgical fastener deployment system of claim 98, wherein the guide is located at a distal end of the first shaft.

107. The surgical fastener system of claim 98, further comprising a guide rod positioned inside the first shaft, wherein the guide rod is shaped and configured to support the at least one coil fastener, and wherein rotation of the guide rod causes the at least one coil fastener to rotate and move towards a distal end of the first shaft.

108. The surgical fastener system of claim 98, wherein the deflectable latch has a length of 5.5 mm to 9 mm.

109. The surgical fastener system of claim 98, wherein the deflectable latch has a thickness of 0.1 mm to 1 mm.

110. The surgical fastener system of claim 98, wherein the deflectable latch has a width of 0.3 mm to 3 mm.

111. A surgical fastener deployment system comprising:

a first shaft including a proximal end and a distal end, wherein the first shaft is configured to include at least one coil fastener disposed in the first shaft, wherein the at least one coil fastener includes a head attached to a coil body extending from the head, and wherein the at least one coil fastener includes a distal most fastener; and

a plurality of guides, wherein the plurality of guides are spaced around at least a portion of a circumference of the first shaft, wherein the plurality of guides are spaced along at least a portion of a length of the first shaft, wherein the plurality of guides are configured to guide the coil body of the at least one coil fastener as the at least one coil fastener is moved in a distal direction, and wherein the plurality of guides are configured to deflect out of a path of the head of the at least one coil fastener as the at least one coil fastener is moved in a distal direction.

112. The surgical fastener deployment system of claim 111, further comprising the at least one coil fastener.

10 113. The surgical fastener deployment system of claim 111, wherein the plurality of guides comprises a first guide positioned at a distal most end of the first shaft.

114. The surgical fastener deployment system of claim 111, wherein the plurality of guides form a helical pattern along the portion of the first shaft.

15 115. The surgical fastener deployment system of claim 114, wherein a helix angle of the plurality of guides is equal to a helix angle of the coil body.

116. The surgical fastener deployment system of claim 111, wherein the plurality of guides comprises a first guide positioned at a distal most end of the first shaft and a second guide within one coil fastener length proximal of the first guide, wherein the first guide and the second guide are configured to engage the coil body of the distal most coil fastener as it is deployed out of the system.

117. The surgical fastener system of claim 111, further comprising a guide rod positioned inside the first shaft, wherein the guide rod is shaped and configured to support the at least one coil fastener, and wherein rotation of the guide rod causes the at least one coil fastener to rotate and move towards a distal end of the first shaft.

25 118. The surgical fastener deployment system of claim 117, wherein the guide is configured to prevent at least one selected from the group of compression, radial expansion,

and lateral deflection of the coil body as the coil fastener is deployed from the distal most end of the surgical fastener deployment system.

119. The surgical fastener deployment system of claim 114, wherein the coil body includes a plurality of coil windings, and wherein the coil windings include interior opposing
5 surfaces disposed on opposite sides of a long axis of the coil fastener.

120. The surgical fastener deployment system of claim 114, wherein the head has a maximum transverse dimension larger than a maximum transverse dimension of the coil body.

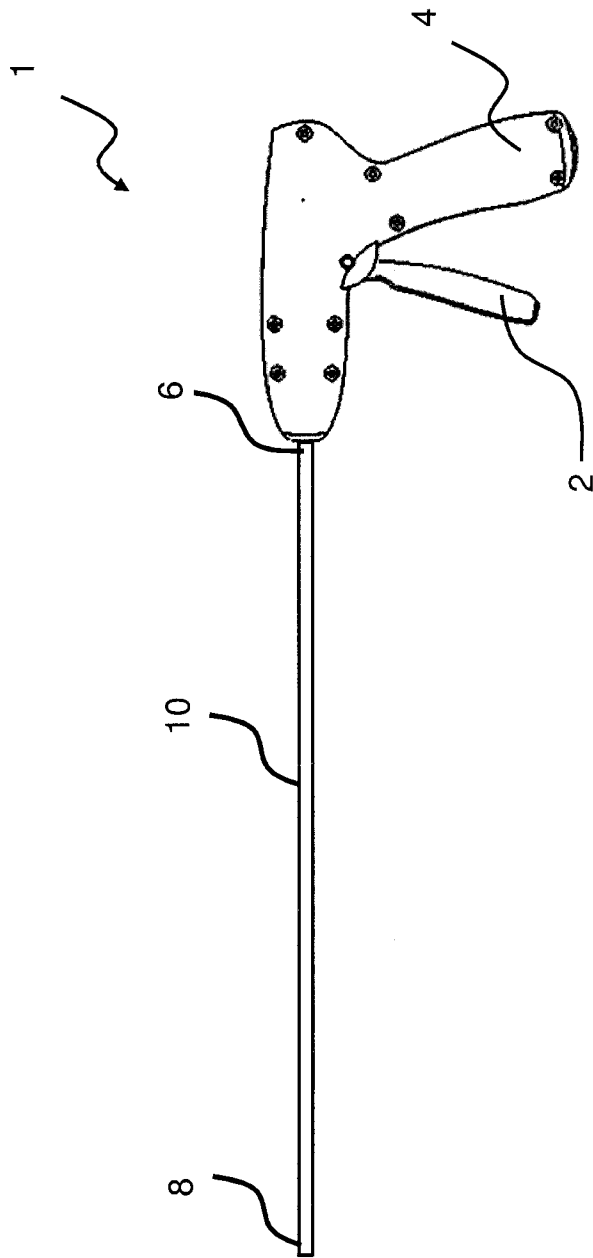


FIG. 1

FIG. 2A

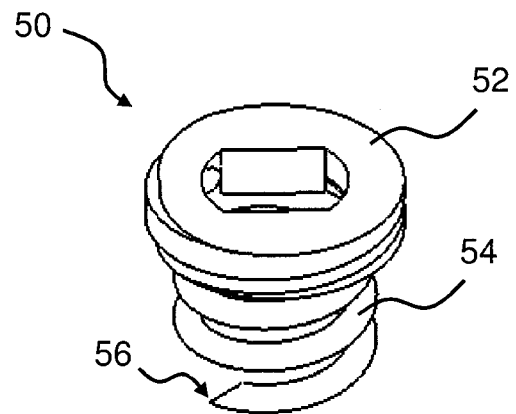


FIG. 2B

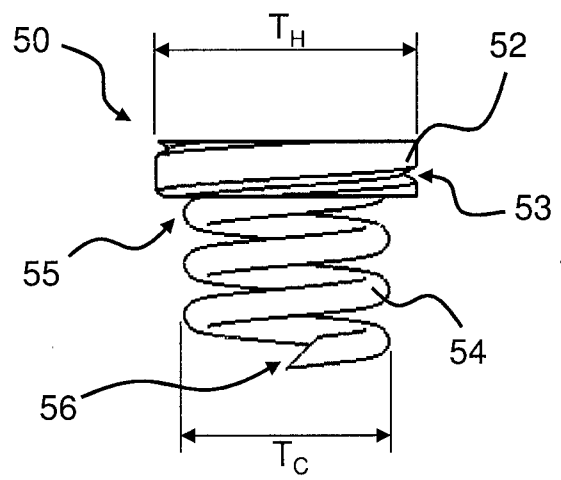
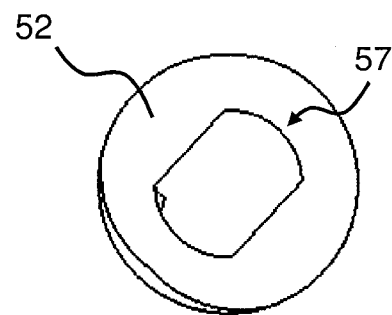


FIG. 2C



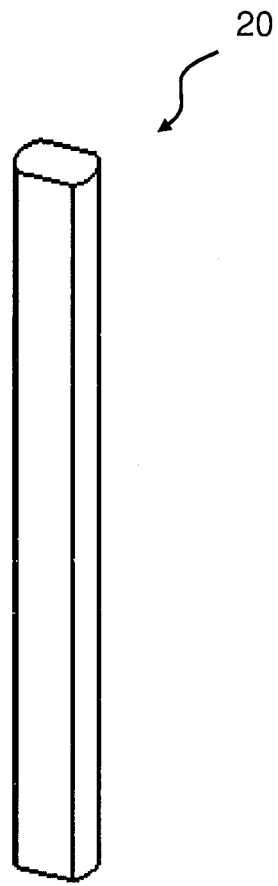


FIG. 3A

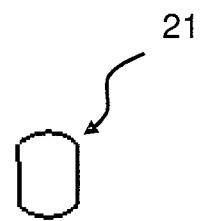


FIG. 3B



FIG. 4A

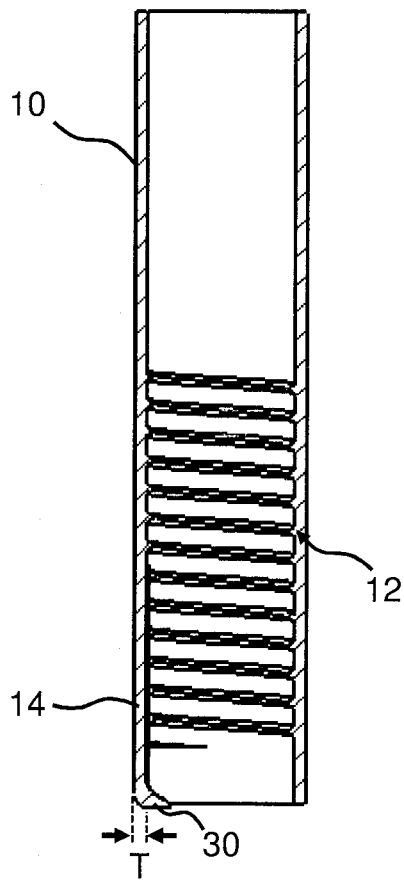


FIG. 4B

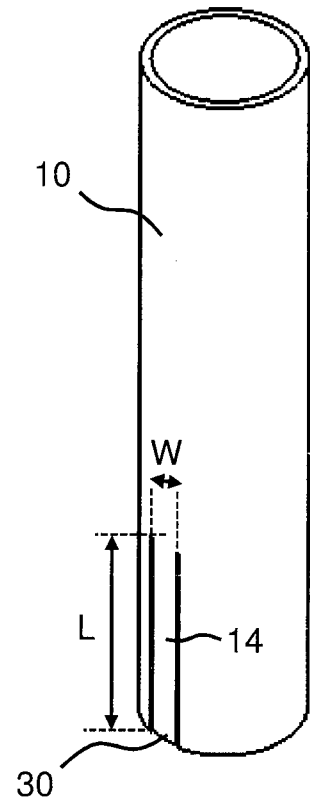


FIG. 4C

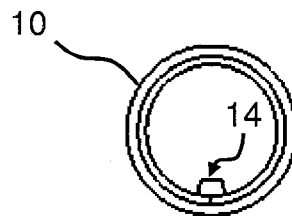


FIG. 4D

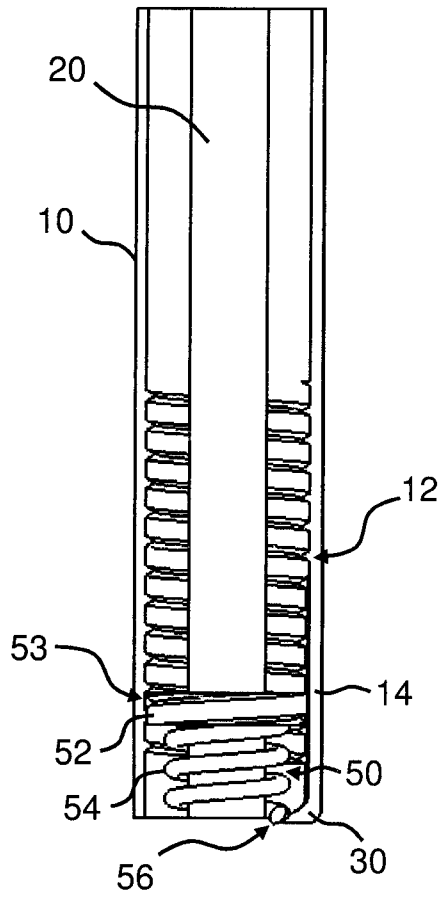


FIG. 5A

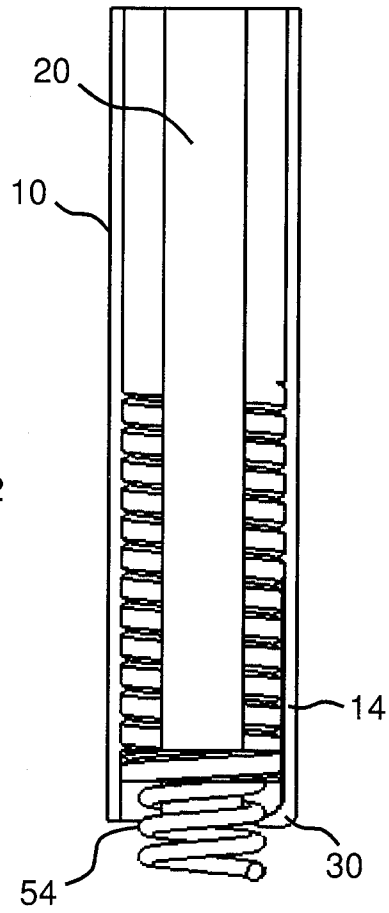


FIG. 5B

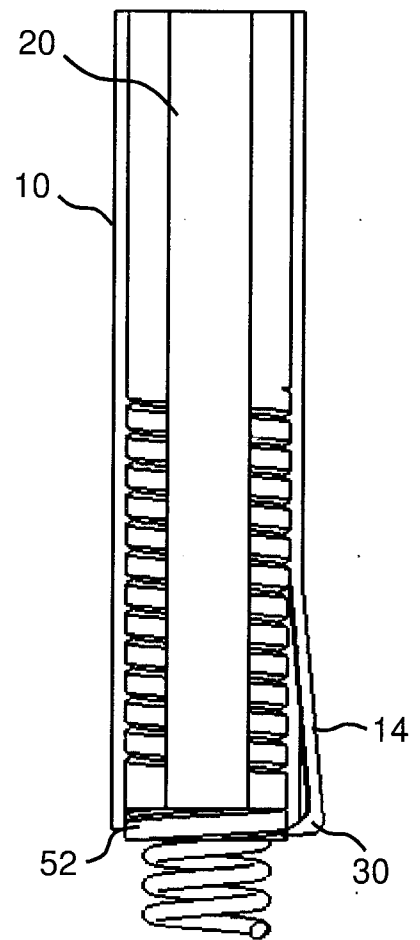


FIG. 5C

