US 20060276680A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0276680 A1**

Seiler et al. (43) **Pub. Date: Dec. 7, 2006**

(54) **APPARATUSES AND METHODS FOR PERCUTANEOUSLY IMPLANTING OBJECTS IN PATIENTS**

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(21) Appl. No.: **11/505,598**

(22) Filed: **Aug. 16, 2006**

Related U.S. Application Data

(63) Continuation of application No. 10/334,699, filed on Dec. 30, 2002.

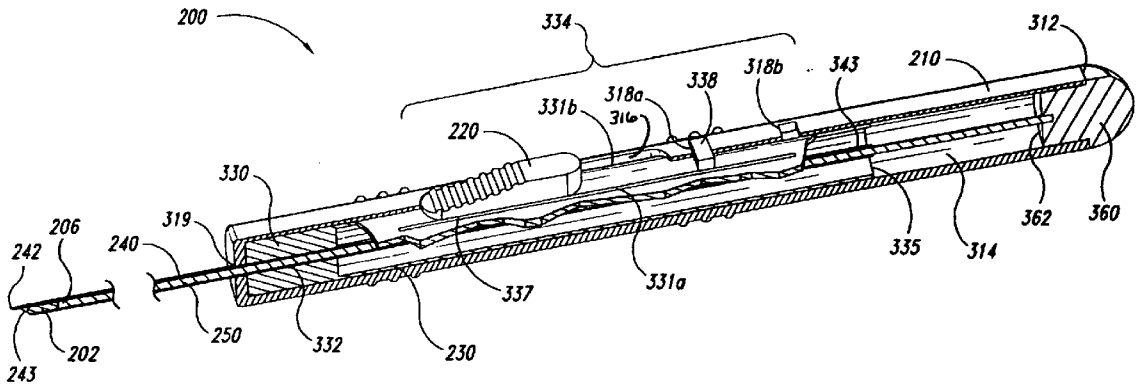
Publication Classification

(51) **Int. Cl.**
A61M 36/00 (2006.01)

(52) **U.S. Cl.** **600/7**

(57) **ABSTRACT**

Apparatuses and methods for percutaneously implanting objects, such as radioactive seeds or markers, in patients. In one embodiment, a device for percutaneously implanting an object in a patient includes a handle, a cannula projecting outwardly from the handle, and an actuator movably disposed relative to the handle. In one aspect of this embodiment, the cannula can be configured to releasably hold the object and percutaneously penetrate the patient. In another aspect of this embodiment, the actuator can be operably connected to the cannula and operable to move the cannula relative to the handle and release the object within the patient. In a further aspect of this embodiment, the cannula can include a tip portion having a restriction configured to releasably hold the object for implantation in the patient.



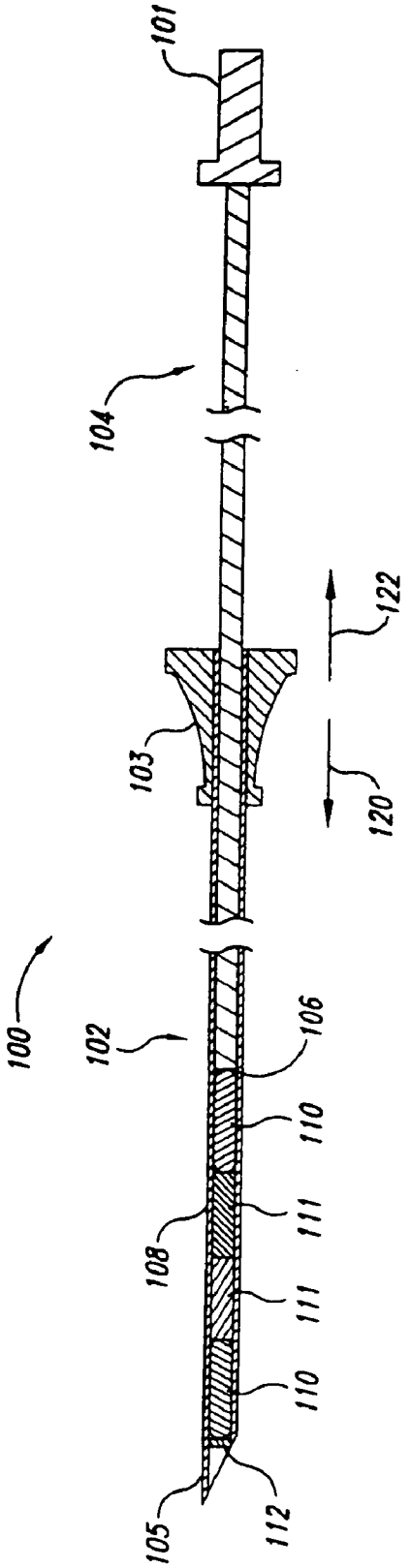


Fig. 1A
(Prior Art)

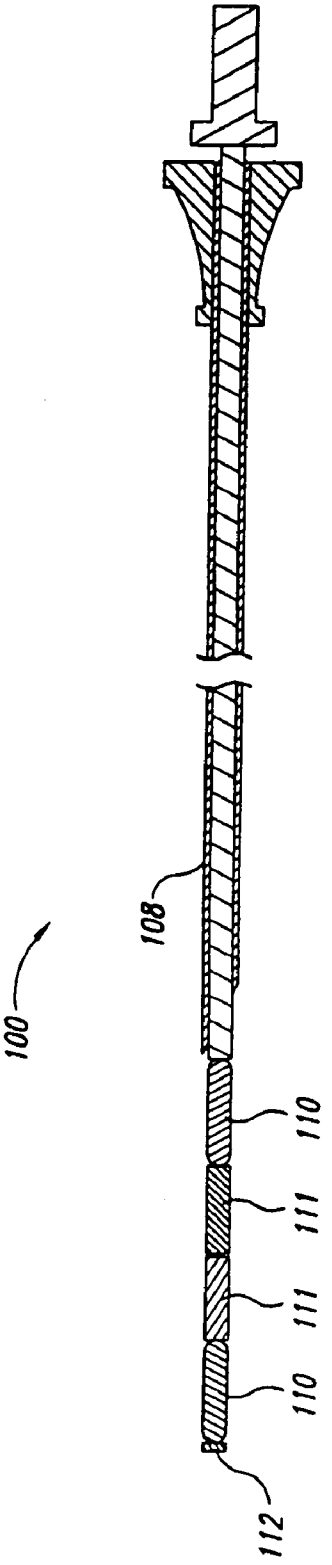


Fig. 1B
(Prior Art)

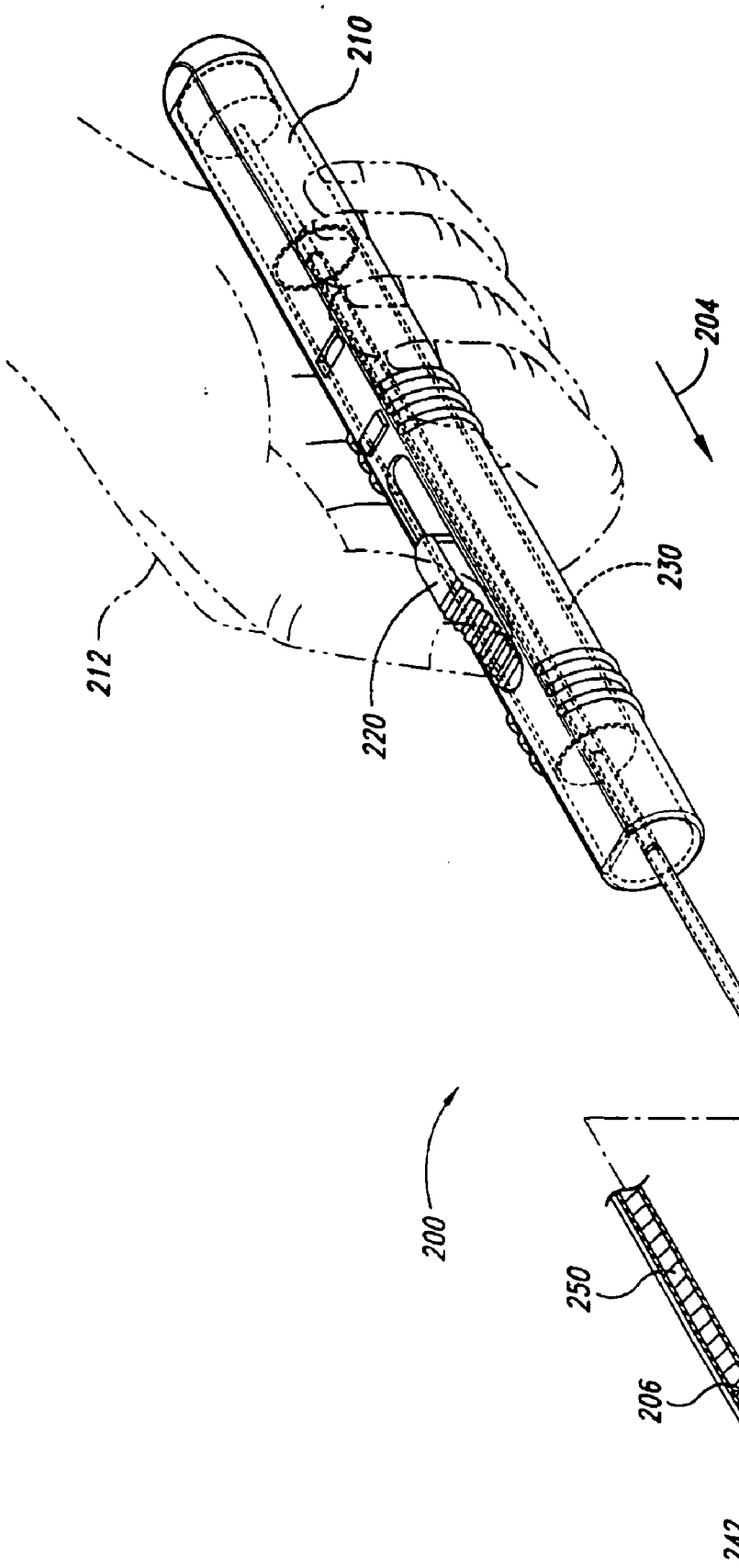


Fig. 2A

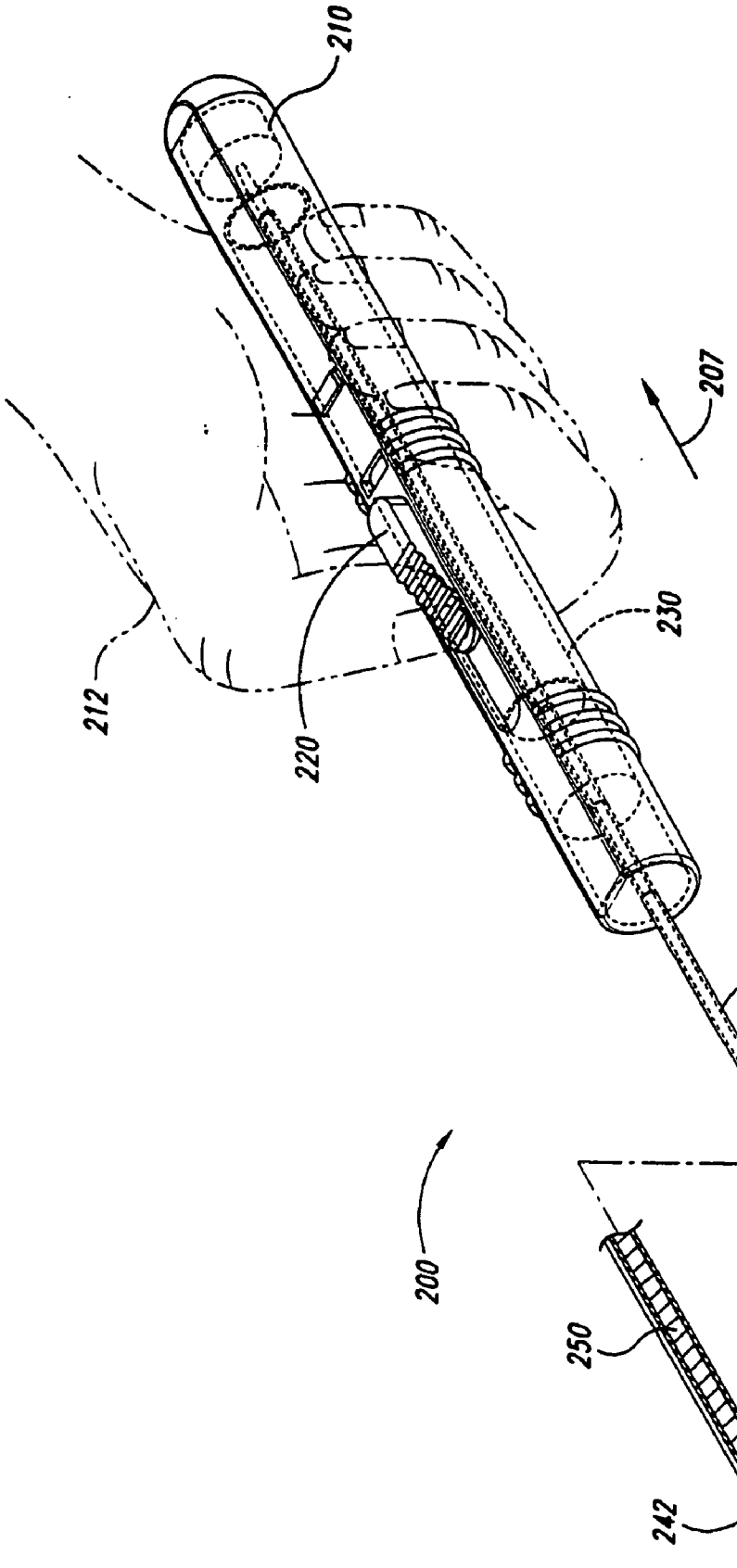


Fig. 2B

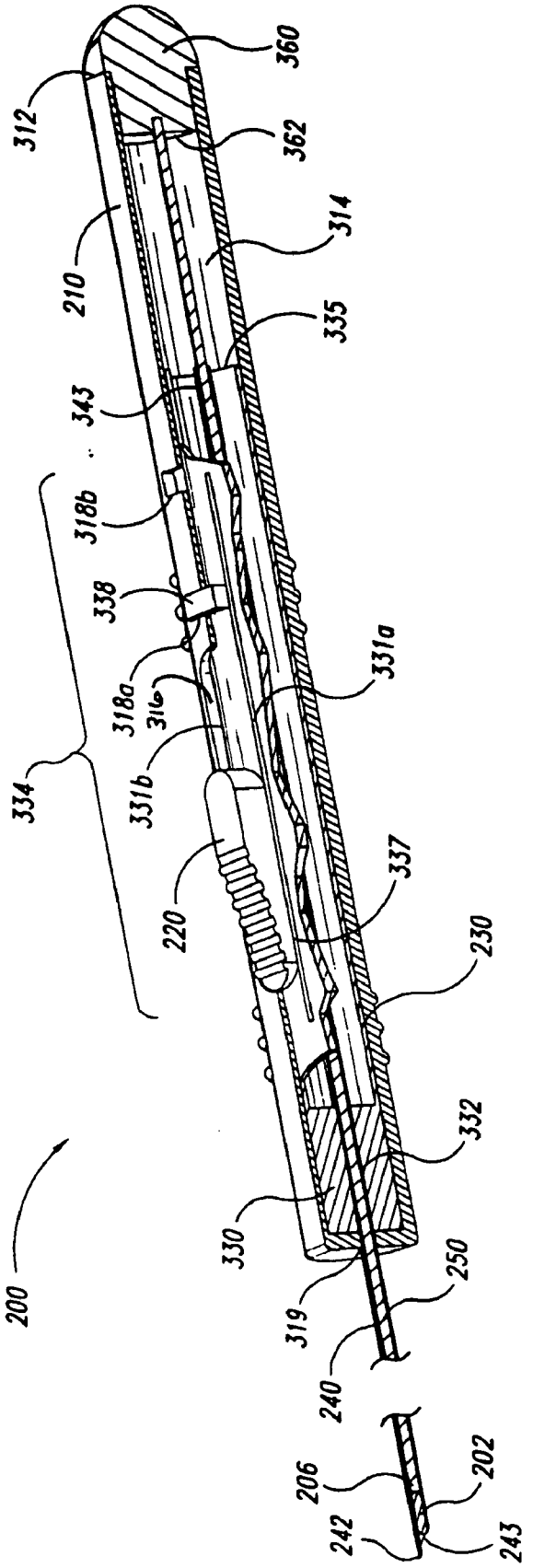

360
312
362
314
210
335
343
318b
338
331a
318a
316
334
331b
337
220
230
332
330
250
319
240
206
202
242
243
200

Fig. 3

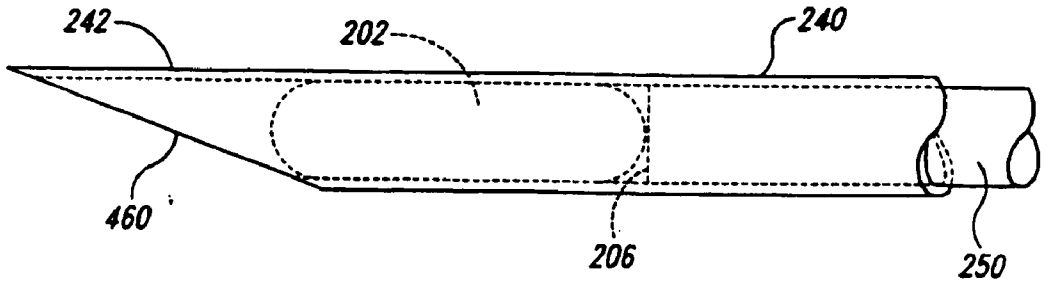


Fig. 4A

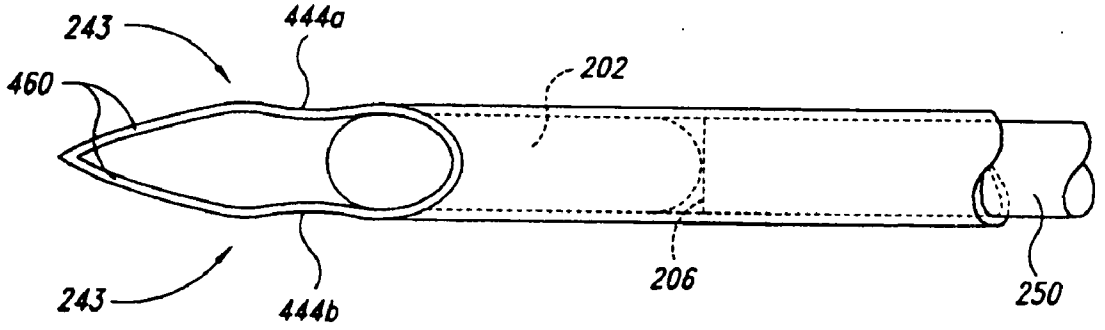


Fig. 4B

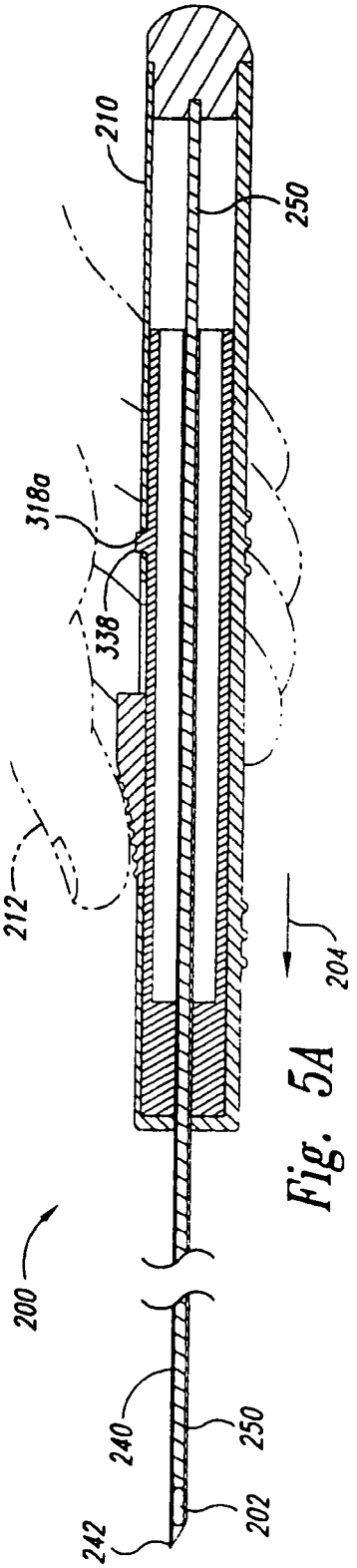


Fig. 5A

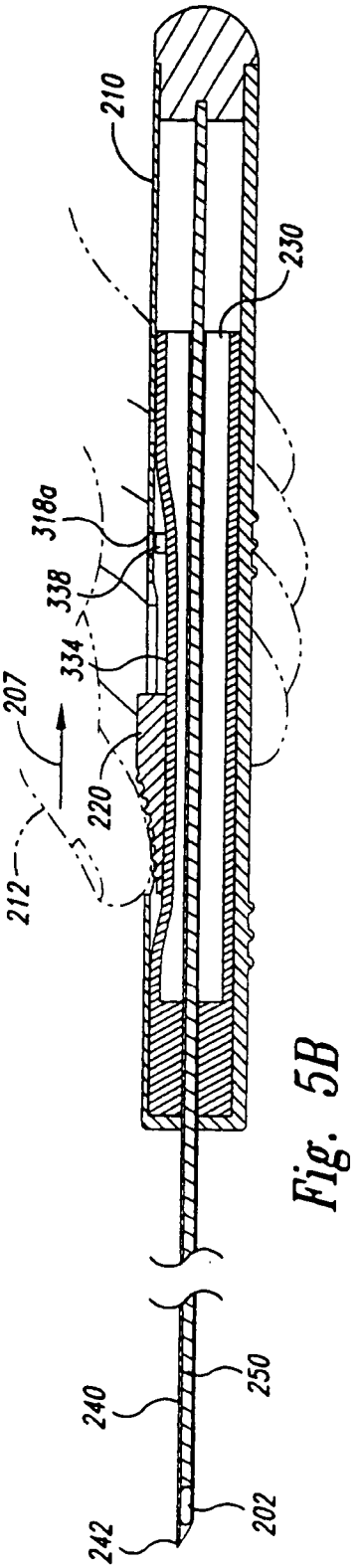


Fig. 5B

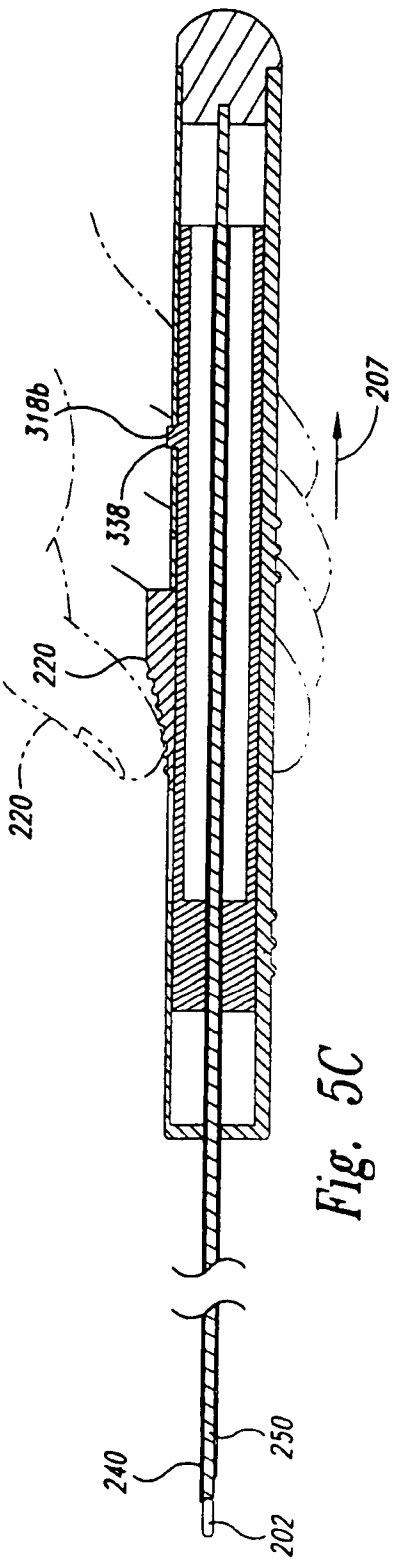


Fig. 5C

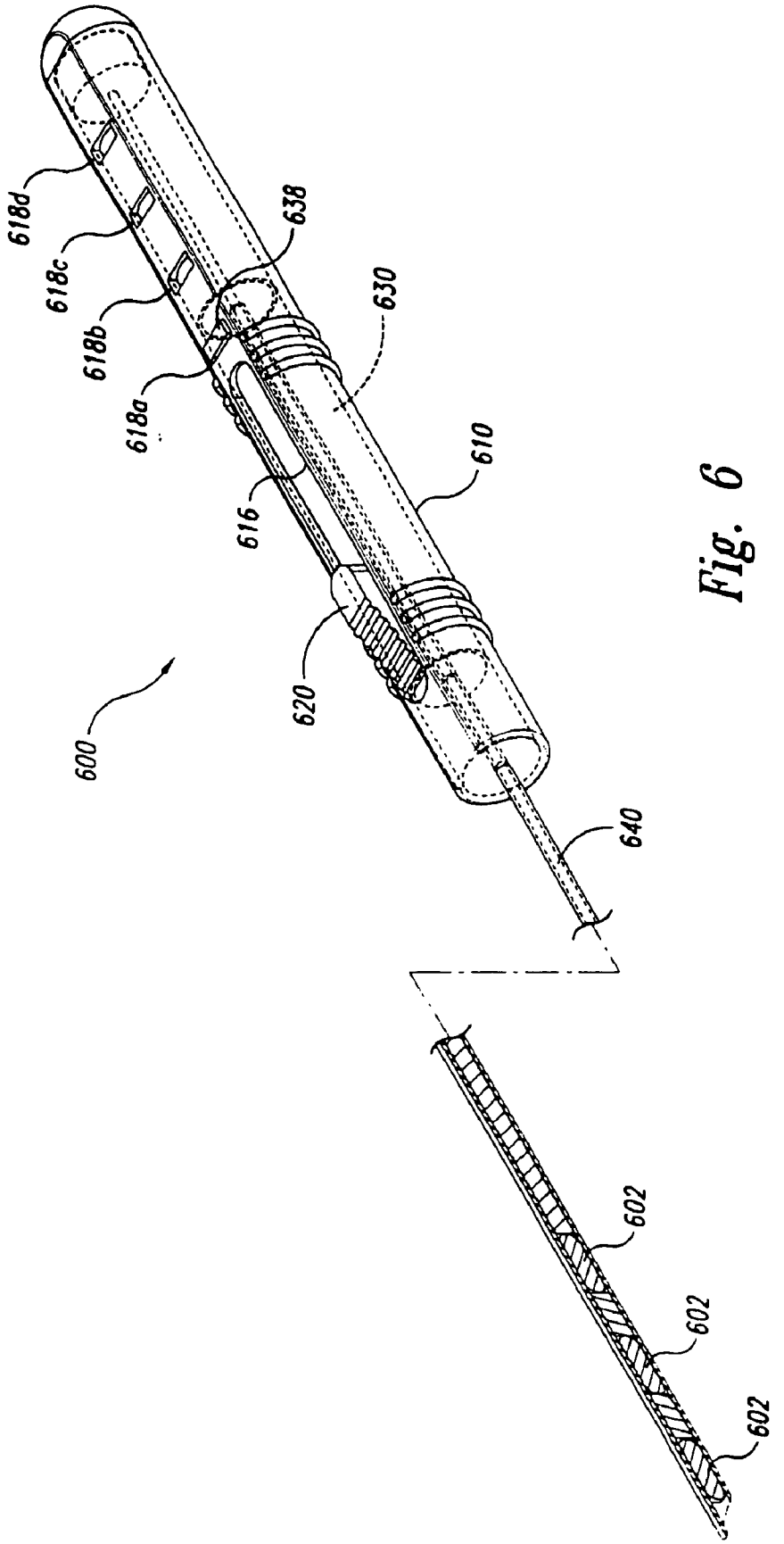


Fig. 6

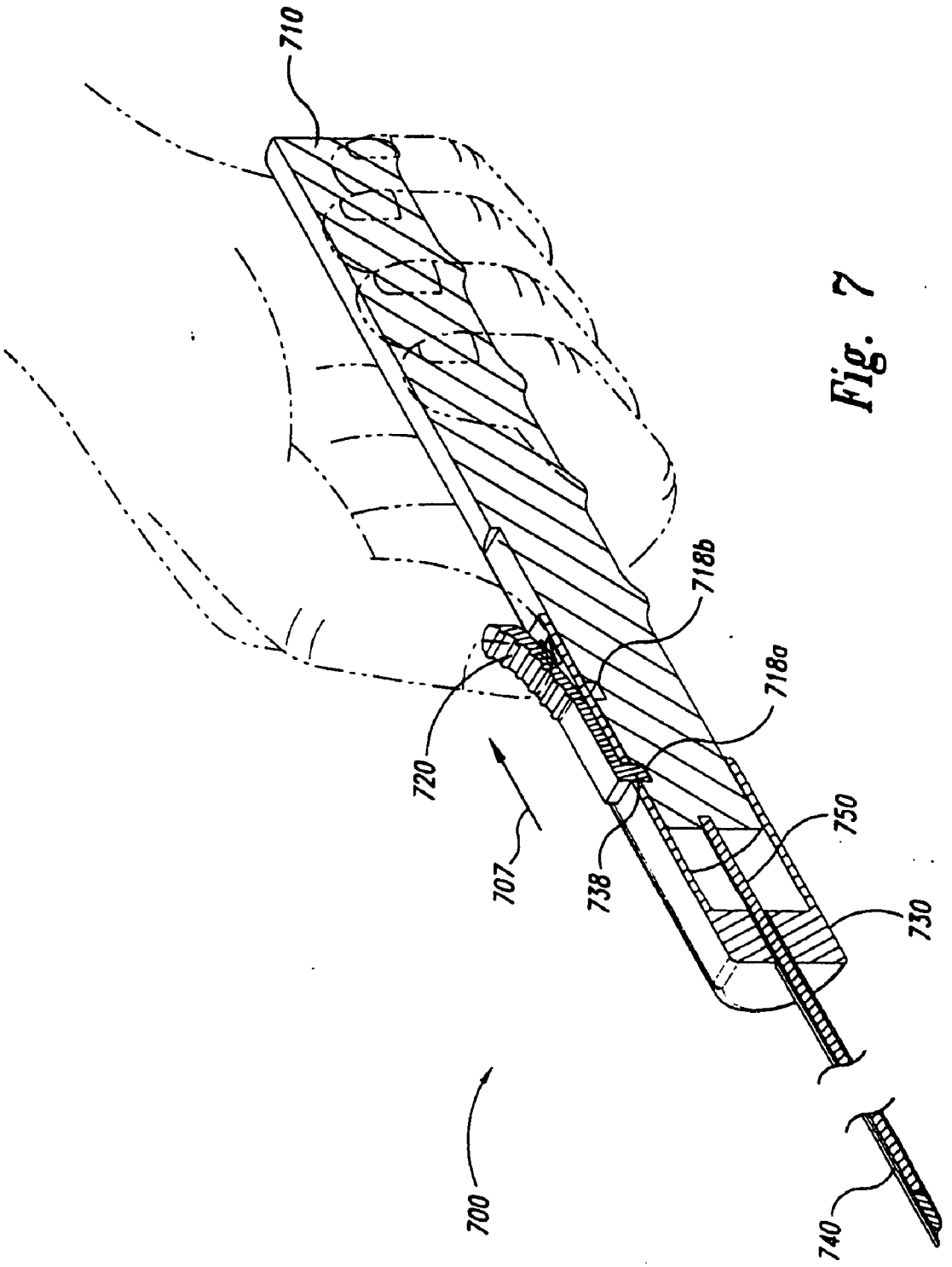


Fig. 7

APPARATUSES AND METHODS FOR PERCUTANEOUSLY IMPLANTING OBJECTS IN PATIENTS

TECHNICAL FIELD

[0001] The following disclosure relates generally to medical devices for percutaneously implanting markers or other small objects in patients.

BACKGROUND

[0002] A number of existing medical treatments involve percutaneously inserting or implanting objects in a patient. One such treatment is brachytherapy for prostate cancer. In brachytherapy, radioactive sources or "seeds" are implanted relative to a tumor to provide a high dose of radiation to the tumor but not the surrounding healthy tissue. Other oncological treatments involve percutaneously implanting radiopaque markers or signal-generating markers adjacent to the tumor. The markers identify the location of the tumor so that a high dose of radiation from a linear accelerator or other external source can be focused directly at the tumor.

[0003] **FIGS. 1A and 1B** are cross-sectional views of a two-piece introducer **100** of the prior art. Referring first to **FIG. 1A**, the introducer **100** includes a needle **102** and a stylet **104** slidably disposed within the needle **102**. The stylet **104** includes a first handle **101** and a blunt distal end **106**. The needle **102** includes a second handle **103** and a cannula **108** extending through the second handle **103**. The cannula **108** is configured to hold radioactive seeds **110** or other objects. The cannula **108** has a distal tip **105** configured to percutaneously penetrate the patient for implantation of the seeds **110** in the patient. Inert spacers **111** can be used to provide the desired spacing between the seeds **110** when the seeds **110** are implanted in the patient. The seeds **110** and spacers **111** are retained in the cannula **108** by a plug **112** made from bone wax or other suitable bio-compatible materials.

[0004] To implant the seeds **110** at a target location in a patient (not shown) in the desired pattern as loaded in the cannula **108**, an operator (also not shown) pushes the cannula **108** in a first direction **120** to insert the tip **105** into the patient. The operator then pushes the second handle **103** further in the first direction **120** to position the Up **105** at the desired depth within the patient where the seeds **110** are to be released. Throughout this motion, the operator moves the needle **102** and the stylet **104** together as a unit. At the desired depth, the operator grasps the first handle **101** with one hand and the second handle **103** with the other hand and, while holding the first handle **101** stationary, slides the second handle **103** back in a second direction **122** toward the first handle **101**. As shown in **FIG. 1B**, this movement causes the cannula **108** to pull back from the plug **112**, the seeds **110**, and the spacers **111** to implant them in the patient.

[0005] One shortcoming of the prior art introducer **100** is that the two-handed movement required to properly release the seeds **110** at the target location and in the desired pattern may be somewhat awkward and nonintuitive. As a result, the operator is prone to err and may inadvertently misplace the seeds **110**. For example, to properly release the seeds **110**, the operator must hold the first handle **101** stationary while sliding the second handle **103** back in the second direction **122** toward the first handle **101**. If, instead, the operator accidentally pushes the first handle **101** toward the second handle **103**, then the stylet **104** may push the seeds **110** out of the cannula **108** in the first direction **120**. This movement could cause the seeds **110** and the spacers **111** to collide in a "train wreck" just beyond the tip **105** of the cannula **108**. Either way, the seeds will not be positioned accurately relative to the target location or in the desired pattern. A further shortcoming of the prior art introducer **100** is that the bone wax used for the plug **112** in brachytherapy applications may melt prematurely allowing the seeds **110** to migrate out of the cannula **108** before reaching the desired target location. As such, conventional introducers for brachytherapy applications are custom loaded at the treatment facility and are not suitable for being transported in warm environments.

SUMMARY

[0006] The invention is directed to apparatuses and methods for implanting markers, radioactive seeds or other small objects in patients. In one aspect, a device for percutaneously implanting an object in a patent includes a handle, a cannula projecting outwardly relative to the handle, and an actuator operably connected to the cannula and movably disposed relative to the handle. The cannula can have a proximal portion positioned proximate to the handle and a distal portion configured to releasably hold the object and percutaneously penetrate the patient by movement of the handle. The actuator can be operable to slide the cannula relative to the handle and release the object within the patient.

[0007] In another aspect, the device can further include a stylet extending at least partially within the cannula and being fixedly positioned with respect to the handle.

[0008] Operating the actuator to slide the cannula relative to the handle causes the cannula to slide relative to the stationary stylet and release the object within the patient.

[0009] In a further aspect, the cannula can include a tip portion having a restriction configured to releasably hold the object for implantation in the patient, and the actuator can be selectively movable from a first position to a second position. When the actuator is in the first position, the tip portion of the cannula can at least generally retain the object. When the actuator is in the second position, the cannula can be drawn back from the object to overcome the restriction and release the object within the patient.

[0010] In yet another aspect, a method for percutaneously implanting an object in a patient includes moving a handle to percutaneously insert a cannula projecting from the handle within the patient, and moving the cannula relative to the handle to release the object within the patient. Moving the cannula relative to the handle can include sliding the cannula with respect to a stationary stylet extending coaxially through at least a portion of the cannula. Moving the handle to percutaneously insert the cannula can include driving the handle forward with a hand of an operator. Further, moving the cannula relative to the handle to release the object within the patient can include manipulating an actuator with a digit of the hand of the operator to move the cannula aft relative to the handle while the handle remains stationary in the hand of the operator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIGS. 1A and 1B** are cross-sectional views of a two-piece introducer of the prior art.

[0012] **FIGS. 2A and 2B** are hidden isometric views of an introducer in accordance with an embodiment of the invention with a distal portion of the introducer shown in cross-section.

[0013] **FIG. 3** is a cut-away isometric view of the introducer shown in **FIGS. 2A and 2B** in accordance with an embodiment of the invention with a portion of the introducer shown in cross-section.

[0014] **FIGS. 4A and 4B** are enlarged hidden side and bottom views, respectively, of a tip portion of a cannula in accordance with an embodiment of the invention.

[0015] FIGS. **5**A-C are enlarged cross-sectional views of the introducer shown in **FIGS. 2A and 2B** illustrating operation of an actuator in accordance with embodiments of the invention.

[0016] **FIG. 6** is a hidden isometric view of an introducer in accordance with another embodiment of the invention with a distal portion of the introducer shown in cross-section.

[0017] FIGS. **7** is a cross-sectional isometric view of an introducer having an external actuator in accordance with another embodiment of the invention.

DETAILED DESCRIPTION

[0018] The following disclosure describes medical devices and methods for percutaneously implanting objects, such as radioactive seeds or markers, in patients.

[0019] Certain specific details are set forth in the following description and in **FIGS. 2A-6B** to provide a thorough understanding of various embodiments of the invention. Certain well-known details often associated with such medical devices are not set forth in the following disclosure to avoid unnecessarily obscuring the various embodiments of the invention. Further, those of ordinary skill in the relevant art will understand that they can practice other embodiments of the invention without several of the details described below. [001] In the drawings, identical reference numbers identify identical or at least generally similar elements. To facilitate the discussion of any particular element, the most significant digit or digits of any reference number refer to the figure in which that element is first introduced. For example, element **210** is first introduced and discussed with reference to **FIG. 2A**.

[0020] **FIGS. 2A and 2B** are hidden isometric views of an introducer **200** in accordance with an embodiment of the invention with a distal portion of the introducer being cut-away. Referring first to **FIG. 2A**, one embodiment of the introducer **200** includes a handle **210**, a hollow needle or cannula **240** projecting outwardly from the handle **210**, and an actuator **230** fixedly attached to the cannula **240** and movably disposed within the handle **210**. The cannula **240** has a proximal portion slidably disposed within the handle **210** and a distal tip portion **242**. The cannula **240** can be a 14 gauge needle or smaller in many applications. The introducer **200** also includes a stylet **250** extending coaxially within the cannula **240**. The stylet **250** can be fixedly attached relative to the handle **210** and can include a blunt distal end **206**. The actuator **230** can include a button **220** manually operable to move the actuator **230** and the cannula **240** fore and aft with respect to the stylet **250** using a digit of a single hand.

[0021] A signal-generating marker **202**, a radio-active seed or other implantable object is slidably positioned in the cannula **240** between the distal end **206** of the stylet **250** and the tip portion **242** of the cannula **240**. The tip portion **242** can be configured to percutaneously penetrate the patient for implantation of the marker **202**, and can include a restriction **243** configured to releasably retain the marker **202** in the cannula **240** prior to release of the marker **202** in the patient. In other embodiments, the cannula **240** can hold other objects for implantation in the patient in addition to the marker **202**. For example, in another embodiment, the cannula **240** can hold additional markers optionally spaced apart by one or more spacers to provide a desired marker pattern. Similarly, in a further embodiment, the cannula **240** can hold a plurality of radioactive seeds optionally spaced apart by one or more spacers to provide a desired seed pattern.

[0022] To percutaneously implant the marker **202** in a patient (not shown), an operator **212** grasps the handle **210** in one hand and aligns the cannula **240** with a desired point of entry on the patient. The operator **212** then moves the handle **210** in a forward direction **204** to position the tip portion **242** of the cannula **240** at the target location within the patient (for example, proximate to a tumor). During this movement, the cannula **240** is held stationary relative to the stylet **250**. Referring next to **FIG. 2B**, after the tip portion **242** is at the target location, the operator **212** uses a single hand to move the button **220** in an aft direction **207** relative to the handle **210** and hold the stylet **250** stationary relative to the handle **210**. This movement draws the cannula **240** back in the aft direction **207** over the marker **202** and the stylet **250**. The stylet **250** is fixed to the handle **210** and remains stationary so that the marker **202** is implanted in the patient as the cannula **240** moves aftward. The operator **212** can now move the handle **210** in the aft direction **207** to retract the cannula **240** from the patient.

[0023] One feature of embodiments of the introducer **200** shown in **FIGS. 2A and 2B** is that the operator can accurately release the marker **202** in the patient by a single movement of a digit of one hand. More specifically, because the stylet **250** is fixed to the handle **210** and the actuator **230** is operated by the operator's hand that holds the handle **210**, the stylet **250** cannot push the markers out of the cannula **240**. An advantage of this feature is that the required movement is intuitive and simple to execute, thus avoiding the possibility of driving the markers out of the cannula causing a "train wreck." In contrast, the prior art introducer **100** of **FIGS. 1A and 1B** requires a potentially awkward two-handed movement to properly release objects at a target location within a patient. The intuitive movement of the prior art device is to move the handles **101** and **103** (**FIG. 1A**) toward each other. As a result, an operator of the prior art introducer **100** is prone to err and may inadvertently misplace the objects.

[0024] **FIG. 3** is a cross-sectional isometric view of the introducer **200** shown in **FIGS. 2A and 2B** in accordance with an embodiment of the invention. In one aspect of this embodiment, the stylet **250** is fixedly attached to an end cap **360**. The end cap **360** can include an engagement portion **362** configured to be received in a handle opening **312** in the handle **210**. In the illustrated embodiment, the distal end **206** of the stylet **250** can be at least generally blunt. In other embodiments, the distal end **206** can have other shapes

depending on the particular application. For example, in other embodiments, the distal end **206** can have a beveled or pencil-point shape.

[**0025**] In another aspect of this embodiment, the actuator **230** is at least generally hollow and includes a body **330**, a bore **332** through the body **330**, a position selector **334**, and an opening **335** at one end of the body **330** opposite the bore **332**. A proximal end of the cannula **240** is positioned in the bore **332** and fixedly attached to the body **330**. The cannula **240** can extend from the opening **335** and project outwardly from the bore **332**. The position selector **334** of the illustrated embodiment includes an indexing feature or protruding tab **338** and a button pad **337** for mounting the button **220**. First and second slits **331**a and **331**b are positioned on opposite sides of the position selector **334** and allow the protruding tab **338** to deflect resiliently inward in response to depression of the button **220**.

[**0026**] In a further aspect of this embodiment, the handle **210** is at least generally hollow and includes an interior portion **314** and a cannula opening **319**. The interior portion **314** can be configured to slidably receive the actuator **230**, and the cannula opening **319** can be configured to allow the cannula **240** to slide freely back and forth with respect to the handle **210** as the actuator **230** moves back and forth within interior portion **314** of the handle **210**.

[**0027**] In yet another aspect of this embodiment, the handle **210** further includes a button opening **316** and locking features **318**. In the illustrated embodiment, the locking features **318** include a first tab opening **318**a and a second tab opening **318**b. The locking features **318** can be configured to selectively receive the protruding tab **338** of the position selector **334** as the operator (not shown) moves the position selector **334** fore and aft in the handle **210** with the button **220**. As will be explained in greater detail below, in other embodiments, the handle **210** can include more locking features depending on the number of markers **202** or other objects the introducer **200** is configured to implant.

[**0028**] The introducer **200** can be assembled by inserting the cannula **240** through the handle opening **312** and the cannula opening **319** until the button pad **337** is aligned with the button opening **316** and the protruding tab **338** engages the first locking feature **318**a. The button **220** is then fixedly attached to the button pad **337**. The marker **202** can then be inserted into the cannula **240** through a cannula inlet **343** at the proximal end of the cannula **240**. In other embodiments, the marker **202** can be inserted into the distal end of the cannula. The cannula inlet **343** can be flared or otherwise configured for smooth loading of the marker **202** or other objects, such as seeds and/or spacers. The distal end **206** of the stylet **250** is then inserted into the cannula inlet **343** and moved through the cannula **240** driving the marker **202** through the cannula **240** until the engagement portion **362** of the cap **360** mates with the handle opening **312**. At this point the marker **202** is releasably held in the cannula **240** between the distal end **206** of the stylet **250** and the restriction **243** of the tip portion **242**.

[**0029**] **FIGS. 4A and 4B** are enlarged hidden side and bottom views, respectively, of the tip portion **242** of the cannula **240** in accordance with an embodiment of the invention. Referring first to **FIG. 4A**, in one aspect of this embodiment, the tip portion **242** includes a beveled edge **460** configured to facilitate percutaneous penetration of the patient. In other embodiments, the tip portion **242** can have other configurations for facilitating percutaneous penetration. For example, in another embodiment, the tip portion **242** can include a double-beveled edge.

[**0030**] Referring now to **FIG. 4B**, in another aspect of this embodiment, the restriction **243** includes a first crimp **444**a and a second crimp **444**b formed in the beveled edge **460**. The crimps **444** can be shaped and sized to reduce the width of the cannula **240** to be less than the diameter of the marker **202**. This reduction in width can be tailored to provide a small resistance sufficient to retain the marker **202** in the cannula **240** until the tip portion **242** moves aft over the distal end **206** of the stylet **250**. The restriction can be further tailored to provide the required resistance without scratching or otherwise damaging the marker **202** or, as the case may be, other objects such as radioactive seeds that can be implanted with the introducer **200** (**FIGS. 2A and 2B**). In other embodiments, other types of restrictions can be used to releasably retain the marker **202** in the cannula **240**. For example, in another embodiment, the restriction can include only a single crimp on one side of the cannula **240**. In a further embodiment, the restriction can include material added to the tip portion **242** proximate to the beveled edge **460**, such as weld material or cured adhesive. In yet another embodiment, the restriction can include a feature machined or otherwise formed into the tip portion **242** proximate to the beveled edge **460**.

[**0031**] One feature of embodiments of the invention shown in FIGS. **4**A-B is that the restriction **243** is only slightly smaller than the outside diameter of the marker **202**. An advantage of this feature is that the restriction **243** provides tactile feedback to the operator (not shown) as the tip portion **242** retracts over the marker **202**. Such tactile feedback provides an indication to the operator that the marker **202** has been released within the patient. This feature can be advantageous when the introducer **200** is used to sequentially implant a plurality of objects, such as a plurality of markers, at different depths within the patient. Another feature of embodiments of the invention shown in FIGS. **4**A-B is that the restriction is positioned at least proximate to and often at the beveled edge **460**. An advantage of this feature is that the beveled edge **460** provides a spring-back effect that further enhances the tactile feedback provided to the operator of the introducer **200**.

[**0032**] Yet another feature of embodiments of the invention shown in FIGS. **4**A-B is that the restriction **243** avoids the use of bone wax or other materials used in the prior art to hold the marker **202** in the cannula **240** prior to release. An advantage of this feature is that these other materials can melt or otherwise fail prematurely allowing the marker **202** to migrate out of the cannula **240** prior to reaching the target location. In contrast, the restriction **243** provides an environmentally stable solution that is not susceptible to fluctuating temperatures. Another advantage is that bone wax is not inadvertently introduced into a patient.

[**0033**] FIGS. **5**A-C are enlarged cross-sectional views of the introducer **200** illustrating operation of the position selector **334** in accordance with embodiments of the invention.

[**0034**] **FIG. 5A** shows the introducer **200** configured for insertion of the cannula **240** into the patient to implant the marker **202**. In this mode, the protruding tab **338** of the

position selector **334** engages the first locking feature **318***a* on the handle **210**, thus holding the cannula **240** stationary relative to the stylet **250**. In **FIG. 5B**, the tip portion **242** is at the target location within the patient and the operator **212** depresses the button **220** causing the protruding tab **338** to disengage from the first locking feature **318***a*. The operator **212** now moves the button **220** in the aft direction **207** sliding the actuator **230** aft in the handle **210**. As shown in **FIG. 5C**, sliding the actuator **230** aft in the handle **210** draws the cannula **240** back over the stationary stylet **250** releasing the marker **202** in the patient. The operator **212** now releases the button **220** allowing the protruding tab **338** to engage the second locking feature **318**b. The operator **212** can now retract the cannula **240** from the patient.

[**0035**] Those of ordinary skill in the relevant art will recognize that the structures described above for controlling the position of the cannula **240** relative to the stylet **250** (such as the position selector **334**, the button **220**, the protruding tab **338**, and the locking features **318**) represent but one embodiment of the present invention. Accordingly, in other embodiments, the features described above can have other details without departing from the spirit or scope of the invention. For example, in another embodiment, the protruding tab **338** and the locking features **318** can be omitted and the position of the actuator **230** can be manually controlled by the operator **212** or can be controlled by a friction surface, such as a serrated surface, existing between the actuator **230** and the handle **210**.

[**0036**] **FIG. 6** is a hidden isometric view of an introducer **600** in accordance with another embodiment of the invention with a distal portion of the introducer shown cut-away. In one aspect of this embodiment, the introducer **600** includes a handle **610**, a cannula **640** projecting outwardly from the handle **610**, and an actuator **630** fixedly attached to the cannula **640** and movably disposed within the handle **610**. The handle **610**, the cannula **640**, and the actuator **630** can be at least approximately similar in structure and function to their counterparts of the introducer **200** described above with reference to **FIGS. 2A-5C**. In another aspect of this embodiment, however, the handle **610** includes an elongated button opening **616** and a plurality of locking features **618** (shown as a first tab opening **618***a*, a second tab opening **618***b*, a third tab opening **618***c*, and a fourth tab opening **618***d*. The locking features **618** are configured to selectively receive a protruding tab **638** projecting from the actuator **630**.

[**0037**] In another aspect of this embodiment, a plurality of markers **602** are slidably positioned in the cannula **640**. Accordingly, an operator (not shown) can sequentially release the markers **602** in a patient (also not shown) by sequentially depressing a button **620** and moving the button **620** aft relative to the handle **610**. With each aft movement, the protruding tab **638** is selectively received by one of the locking features **618**. In this manner, the operator can monitor and control the timing of each marker release. The operator, for example, can implant a first marker **602** at a first target location, reposition the introducer **600**, and implant a second marker **602** at a second location without having to reload the introducer **600**.

[**0038**] FIGS. **7** is a cross-sectional isometric view of an introducer **700** having an external actuator **730** in accordance with another embodiment of the invention. In one aspect of this embodiment, the introducer **700** includes a cannula **740** projecting outwardly relative to a handle **710**. The cannula **740** is fixedly attached to the actuator **730**, and the actuator **730** is slidably disposed over at least a portion of the handle **710**.

[**0039**] The introducer **700** further includes a stylet **750** fixedly attached to the handle **710** and extending coaxially within the cannula **740**. In another aspect of this embodiment, the actuator **730** can include a rocker-button **720** with a protruding tab **738** configured to be selectively received in locking features **718** of the handle **710** (shown as a first locking feature **718***a* and a second locking feature **718***b*. Depressing the rocker-button **720** can disengage the protruding tab **738** from the first locking feature **718***a* and allow the actuator **730** to be slid aft in direction **707** relative to the handle **710**. This action causes the cannula **740** to slide aft over the marker **202** and the stationary stylet **750** releasing the marker **202**.

[**0040**] Although specific embodiments of, and examples for, the present invention are described herein for illustrative purposes, various modifications can be made without departing from the spirit and scope of the invention as will be readily apparent to those of ordinary skill in the relevant art. For example, although introducers are described above for implanting wireless objects, such as radioactive seeds or resonating activatable markers, the teachings of the present invention can also be applied to introducers for implanting markers that are hard-wired to a power source external to the patient. In these embodiments, for example, a suitable hole or other outlet can be provided in the introducer handle as required to accommodate passage of the wire. In addition, although the present disclosure describes manual introducers, in other embodiments, powered introducers that are at least partially automated can also be configured in accordance with embodiments of the present invention.

[**0041**] From the foregoing, it will be appreciated that specific embodiments of the invention have been described herein for purposes of illustration, but that various modifications may be made without deviating from the spirit and scope of the invention. Accordingly, the invention is not limited except as by the appended claims.

1. A device for percutaneously implanting an object in a patient, the device comprising:

a handle;

a cannula having a proximal portion slidably carried proximate to the handle and a distal portion configured to releasably hold the object; and

an actuator connected to the proximal end of the cannula and movably disposed relative to the handle, wherein the actuator comprises an interface element that (a) engages the handle to restrict axial movement between the actuator and the handle, and (b) disengages the handle to allow the cannula to slide axially relative to the handle and release the object within the patient.

2. The device of claim 1, further comprising a stylet extending at least partially within the cannula and being fixedly positioned with respect to the handle, wherein the actuator is selectively movable relative to the handle to slide the cannula relative to the stationary stylet and release the object within the patient.

3. The device of claim 1, further comprising a stylet extending at least partially within the cannula and being fixedly positioned with respect to the handle, wherein the distal portion of the cannula includes a restriction configured to releasably retain the object in the cannula between a distal end of the stylet and the restriction, and wherein the actuator is selectively movable relative to the handle to slide the cannula relative to the stationary stylet and overcome the restriction to release the object within the patient.

4. The device of claim 1 wherein the handle is configured to be held in a single hand of an operator, and wherein the actuator is configured to be manipulated by a digit of the single hand of the operator to slide the cannula relative to the handle and release the object within the patient.

5. The device of claim 1 wherein the interface element of the actuator comprises a position selector, the position selector being manually operable to move the actuator from a first position to a second position, wherein the cannula at least generally retains the object when the actuator is in the first position, and wherein the cannula releases the object when the actuator is moved to the second position.

6. The device of claim 1 wherein the handle is configured to be held in a single hand of an operator, wherein the interface element of the actuator comprises a position selector configured to be manipulated by a digit of the single hand of the operator to move the actuator from a first position to a second position, wherein the cannula at least generally retains the object when the actuator is in the first position, and wherein the cannula releases the object when the actuator is moved to the second position.

7. The device of claim 1 wherein the distal portion of the cannula includes a tip portion configured to percutaneously penetrate the patient, and wherein the tip portion is configured to releasably hold the object for implantation in the patient.

8. The device of claim 7 wherein the tip portion includes a restriction configured to releasably hold the object for implantation in the patient.

9. The device of claim 7 wherein at least a portion of the cannula defines a circular cylinder, and wherein the tip portion includes a deformation of the circular cylinder configured to releasably hold the object for implantation in the patient.

10. The device of claim 7 wherein the tip portion includes at least one crimp in the cannula configured to releasably hold the object for implantation in the patient.

11. The device of claim 1 wherein the handle includes an interior portion and the actuator is slidably disposed at least partially within the interior portion.

12-17. (canceled)

18. A cannula for use in percutaneously implanting an object in a patient, the cannula comprising:

a proximal portion having an inlet configured to receive the object;

an intermediate portion extending distally from the proximal portion; and

a distal portion extending distally from the intermediate portion, the distal portion having a tip with a cutting edge configured to penetrate the skin of the patient and a restriction at the cutting edge configured to releasably hold the object within the cannula prior to release of the object in the patient.

19. The cannula of claim 18 wherein the distal portion and the restriction are formed from a single piece of material.

20. The cannula of claim 18 wherein the restriction comprises a deformation of the distal portion that project inward into a lumen defined by the cannula.

21. The cannula of claim 18 wherein the restriction includes at least one crimp.

22. The cannula of claim 18 wherein the intermediate portion defines a first inner cross-section, and wherein the restriction defines a second inner cross-section less than the first inner cross-section.

23. The cannula of claim 18 wherein the cutting edge is a beveled edge, and wherein the restriction is positioned at least proximate to the beveled edge.

24. The cannula of claim 18 wherein the cutting edge is a beveled edge and the restriction is an inward deformation of the beveled edge.

25. The cannula of claim 18 wherein the inlet is flared to facilitate loading of the object into the cannula.

26. A method for percutaneously implanting an object in a patient, the method comprising:

locking a cannula to a handle in a first position in which the cannula carries an object to be implanted in a patient;

driving the handle and the cannula as a unitary introducer in a distal direction with a single hand of an operator to percutaneously insert a distal end of the cannula into the patient; and

moving the cannula in a proximal direction relative to the handle to release the object within the patient.

27. The method of claim 26 wherein moving the cannula relative to the handle includes sliding the cannula with respect to a stationary stylet fixed to the handle extending coaxially through at least a portion of the cannula.

28. The method of claim 26 wherein moving the handle to percutaneously insert the cannula into the patient includes driving the handle in the distal direction with the single hand of the operator, and wherein moving the cannula in the proximal direction relative to the handle to release the object within the patient includes manipulating an actuator with a digit of the single hand of the operator to move the cannula proximally relative to the handle while the handle remains stationary in the hand of the operator.

29. The method of claim 26 wherein an actuator is movably disposed at least proximate to the handle and connected to the handle, and wherein moving the cannula comprises manipulating the actuator to move the cannula proximally relative to the handle and release the object within the patient.

30. The method of claim 29 wherein a stylet is fixedly attached to the handle and extends through a portion of the cannula, and wherein manipulating the actuator to move the cannula proximally relative to the handle comprises sliding the actuator proximally to slide the cannula proximally over the stylet.

31. The method of claim 29 wherein the actuator comprises a button that is configured to engage the handle in a

first position to restrict relative axial movement therebetween and disengage the handle in a second position to allow axial movement therebetween, and wherein manipulating the actuator to move the cannula relative to the handle and release the object includes moving the button to the first position and sliding the button proximally relative to the handle.

32. The method of claim 26 wherein the cannula includes an inlet, and wherein the method further comprises:

inserting the object into the cannula through the inlet; and

sliding a stylet through the inlet in at least a portion of a lumen of the cannula after the object has been inserted into the lumen to position a distal tip of the stylet against the object.

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