(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 December 2008 (04.12.2008)

PCT

(10) International Publication Number
WO 2008/148011 A1

(51) International Patent Classification:
A61F 2/06 (2006.01) *A61F 2/84* (2006.01)

(21) International Application Number:
PCT/US2008/064728

(22) International Filing Date: 23 May 2008 (23.05.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/753,909 25 May 2007 (25.05.2007) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(54) Title: TWISTED STENT

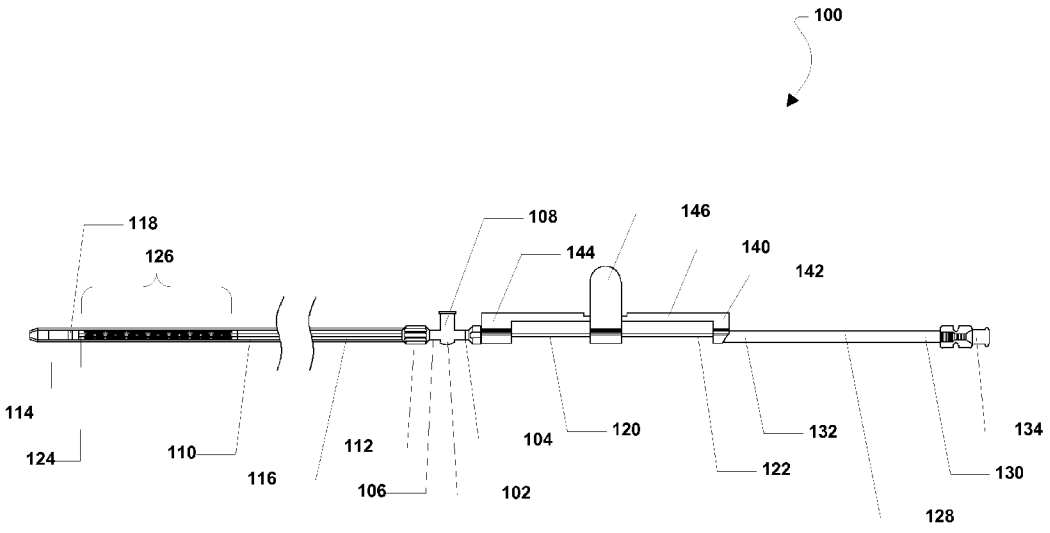

FIG. 1

(57) Abstract: A stent is disclosed and can include a stent body having a longitudinal axis. The stent body can also have a network of struts that can define a plurality of cells defined between interconnected struts. Each of the plurality of cells includes a major axis that is angled with respect to the longitudinal axis to form a cell angle, b.

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TWISTED STENT

FIELD OF THE DISCLOSURE

The present disclosure relates generally to surgical devices. More specifically, the present disclosure relates to stents and stent delivery devices.

BACKGROUND

Vascular stenosis is an abnormal narrowing in a blood vessel. Vascular stenosis can include peripheral artery stenosis, coronary artery stenosis, carotid artery stenosis, and renal artery stenosis. There exist several ways to detect vascular stenosis. For example, a vascular stenosis can be detected using a stethoscope to amplify bruit, i.e., noise, within the blood vessel due to turbulent blood flow through the narrowed blood vessel. Alternatively, one or more imaging methods can be used to detect and locate a vascular stenosis. For example, ultrasound, magnetic resonance imaging, and computed tomography can be used to detect and locate a vascular stenosis.

A common cause of vascular stenosis is atherosclerosis. Atherosclerosis, aka, hardening of the arteries, is a disease that affects the arterial blood vessel. Atherosclerosis is caused by the formation of multiple plaques within the arteries. As plaque builds up within an artery, the diameter of the artery is reduced and results in a stenosis.

Vascular stenosis can be treated using a stent. A stent can be from a shape memory material or a non-shape memory material. A stent made from a non-shape memory material can be installed on a balloon catheter and then, threaded through a patient's cardiovascular system to the stenosis. Once the stent is in place within the stenosis, the balloon catheter can be inflated in order to deform the stent and move the stent to an expanded configuration. Thereafter, the balloon catheter can be deflated and withdrawn from the patient.

A stent made from a shape memory material can be installed on a catheter and a sleeve can be placed over the stent. The catheter and sleeve can be threaded through a patient's cardiovascular system to the stenosis. Once the stent is in place within the stenosis, the sleeve can be removed from the stent. When exposed to the patient's body temperature, the stent automatically can move to an expanded configuration that corresponds to a shape memory configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a stent delivery device;

FIG. 2 is a detailed view of a stent delivery device;

FIG. 3 is a plan view of a handle for a stent delivery device;

FIG. 4 is a cross-section view of the handle;

FIG. 5 is a plan view of the stent delivery device engaged with the handle;

FIG. 6 is a plan view of a stent in a collapsed configuration;

FIG. 7 is a plan view of a stent in an expanded configuration;

FIG. 8 is a plan view of a stent installed on a stent delivery device; and

FIG. 9 is a flow chart illustrating one method of installing and deploying a stent.

DETAILED DESCRIPTION OF THE DRAWINGS

A stent is disclosed and can include a stent body having a longitudinal axis. The stent body can also have a network of struts that can define a plurality of cells defined between interconnected struts. Each of the plurality of cells includes a major axis that is angled with respect to the longitudinal axis to form a cell angle, b.

In another embodiment, a stent is disclosed and can include a stent body having a proximal end and distal end. The stent body can also have a longitudinal axis. The stent is configured to collapse radially about the longitudinal axis as the proximal end is rotated with respect to the distal end.

In yet another embodiment, a method of preparing a stent for deployment is disclosed. The stent can have a proximal end and a distal end. The method can include grasping the proximal end of the stent, grasping the distal end of the stent, and rotating the proximal end and the distal end with respect to each other in order to move the stent to a collapsed configuration.

In still another embodiment, a stent delivery tool is disclosed and can include an inner carrier catheter. The inner carrier catheter can include a stent engagement area that can be configured to engage a twisted stent and prevent the twisted stent from rotating relative to the artery.

DESCRIPTION OF A STENT DELIVERY DEVICE

Referring to FIG. 1, a stent delivery device is shown and is generally designated 100. As shown, the stent delivery device 100 includes a body 102 having a proximal end 104 and a distal end 106. A first syringe attachment 108 can be formed in the body 102 between the proximal end 104 and the distal end 106. In a particular embodiment, the first syringe attachment 108 can be a Luer syringe attachment. The first syringe attachment 108 can provide fluid communication to a lumen formed within an outer sheath 110, described below.

FIG. 1 indicates that the stent delivery device 100 can include an outer sheath 110. The outer sheath 110 can include a proximal end 112 and a distal end 114. Further, the outer sheath 110 can extend from the distal end 106 of the body 102 of the stent delivery device 100. In particular, the

proximal end 112 of the outer sheath 110 can be attached to the distal end 106 of the body 102 of the stent delivery device 100. The distal end 114 of the outer sheath 110 can be relatively soft and rounded. The outer sheath 110 can include a lumen 116 formed therein. Further, the distal end 114 of the outer sheath 110 can include a radiopaque band 118.

As illustrated in FIG. 1, the stent delivery device 100 can further include an inner carrier catheter 120. The inner carrier catheter 120 can extend through the body 102 of the stent delivery device 100 and into the lumen 116 formed in the outer sheath 110. The inner carrier catheter 120 can be coaxial with the outer sheath 110. Further, the inner carrier catheter 120 can include a proximal end 122 and a distal end 124. The inner carrier catheter 120 can be formed with a lumen (not shown) that can be sized to fit over a guide wire. In particular, the lumen of the inner carrier catheter 120 can fit over a 0.035 inch guide wire.

As shown in FIG. 1, a stent 126 can be compressed between the inner carrier catheter 120, e.g., the distal end of the inner carrier catheter 120, and the outer sheath 110. A handle 128 can be attached to, or otherwise extend from, the proximal end 122 of the inner carrier catheter 120. The handle 128 can include a proximal end 130 and a distal end 132. The proximal end 130 of the handle 128 can include a second syringe attachment 134. In a particular embodiment, the second syringe attachment 134 can be a Luer syringe attachment. The second syringe attachment 134 can provide fluid communication with the lumen formed within the inner carrier catheter 120.

The stent delivery device 100 can also include a safety clip 140 installed between the body 102 of the stent delivery device 100 and the handle 128 of the inner carrier catheter 120. The safety clip 140 can include a proximal end 142 and a distal end 144. Further, the safety clip 140 can include a butterfly handle 146 between the proximal end 142 of the safety clip 140 and the distal end 144 of the safety clip 140. In a particular embodiment, the stent delivery device 100 can be installed between the body 102 of the stent delivery device 100 and the handle 128 of the inner carrier catheter 120 such that the proximal end 142 of the safety clip 140 abuts the distal end 132 of the handle 128 and the distal end 144 of the safety clip 140 abuts the proximal end 104 of the body 102.

The safety clip 140 can fit over the inner carrier catheter 120. Further, the safety clip 140 can prevent the body 102 of the stent delivery device 100 from moving relative to the handle 128 of the inner carrier catheter 120. Further, the safety clip 140 can prevent the outer sheath 110 from sliding relative to the inner carrier catheter 120. During use, the stent delivery device 100 can be threaded into a cardiovascular system of a patient to a target area. The radio opaque band 118 formed on the outer sheath 110 can be used to guide the stent delivery device into the cardiovascular system of a patient, e.g., with the aid of fluoroscopy. Further, a pair of radiopaque bands on the stent 126 can aid in positioning the stent 126 within the patient. Once the stent 126 is properly positioned, the butterfly handle 146 can be squeezed in order to remove the safety clip 140 from the inner carrier catheter 120 and the stent delivery device 100. Thereafter, the body 102 of the stent delivery device 100 can be

moved toward the handle of the inner carrier catheter 120 in order to slide the outer sheath 110 off of the stent 126 and expose the stent 126 inside the patient.

Once the stent 126 is exposed within the patient, the stent 126 can be deployed within the patient by exposing the patient to a laser having a wavelength of approximately seven hundred and eighty nanometers (780 nm). The energy can melt a polymer on the stent 126 and allow the stent 126 to move to a shape memory configuration, e.g., an expanded configuration, within the patient, and be deployed within the patient. After the stent 126 is deployed, the inner carrier catheter 120 can be withdrawn from the patient.

FIG. 2 is a detailed view of the inner carrier catheter 120. As shown, the inner carrier catheter 120 can include a stent engagement area 200 near the distal end 124 of the inner carrier catheter 120. As shown, the stent engagement area 200 can include a helical structure 202 extending along the length of the stent engagement area 200. The helical structure 202 can include a helical groove formed in the inner carrier catheter 120. Alternatively, the helical structure 202 can include a raised helical rib, or thread, formed on the inner carrier catheter 120. In a particular embodiment, the helical structure 202 is angled with respect to a longitudinal axis 204 of the inner carrier catheter 120 to form a stent engagement angle 206, α.

In a particular embodiment, α can be greater than zero degrees and less than ninety degrees ($0° < \alpha < 90°$). In another embodiment, α can be greater than one degree and less than sixty degrees ($1° < \alpha < 60°$). In yet another embodiment, α can be greater than two degrees and less than forty-five degrees ($2° < \alpha < 45°$). In still another embodiment, α can be greater than five degrees and less than thirty degrees ($5° < \alpha < 30°$).

As shown in FIG. 2, the inner carrier catheter 120 can include a tip 208 and the stent engagement area 200 can be formed on the tip of the inner carrier catheter 120. The tip 208 of the inner carrier catheter 120 can be disposed on a post 210 formed on the inner carrier catheter 120. Further, the tip 208 of the inner carrier catheter 120 can rotate on the post 210. Accordingly, when a stent is deployed and the inner carrier catheter 120 is withdrawn from the deployed stent, the tip 208 of the inner carrier catheter 120 can rotate within the deployed stent. The deployed stent can remain stationary within an artery in which the stent is deployed.

FIG. 3 and FIG. 4 illustrate a handle assembly, generally designated 300 that can be used in conjunction with the stent delivery system 100, described above. As shown in FIG. 3 and FIG. 4, the handle assembly 300 can include a housing 302. The housing 302 can be hollow and can include a proximal end 304 and a distal end 306.

As depicted in FIG. 4, a rail support structure 308 can be disposed within the housing 302 near the proximal end 304 of the housing 302. A pair of rails 310 can extend between the distal end 306 of the housing 302 and the rail support structure 308. The handle assembly 300 can also include a carrier

312 that can be slidably disposed on the rails 310. In a particular embodiment, the carrier 312 can be configured to receive the body of a stent delivery system, e.g., the stent delivery system 100, described above.

A shaft 314 can extend from the housing 302 near the rail support structure 308, e.g., between the rail support structure 308 and the distal end 306 of the housing 302. In a particular embodiment, the shaft 314 is substantially perpendicular to the rails 310. A ratchet wheel 316 can be rotatably disposed on the shaft 314. The ratchet wheel 316 can be formed with a plurality of teeth 318 around the outer periphery of the ratchet wheel 316. The handle assembly 300 can also include a pawl 320 extending from the rail support structure 308. The pawl 320 can be configured to engage the ratchet wheel 316, e.g., the teeth 318 of the ratchet wheel 316, and permit rotation of the ratchet wheel 316 in a single direction, e.g., clockwise.

FIG. 4 further shows that the handle assembly 300 can include a cable 322. The cable 322 can include a proximal end 324 and a distal end 326. The cable 322 can extend within the housing along the length of the rails 310. Further, the proximal end 324 of the cable 322 can be wrapped, or otherwise disposed, around the ratchet wheel 316. The distal end 326 of the cable 322 can be attached, or otherwise affixed, to the carrier 312. As the ratchet wheel 316 is rotated, the cable 322 can be rolled onto the ratchet wheel 316 and the carrier 312 can slide along the rails 310 toward the proximal end 304 of the housing 302.

As illustrated in FIG. 4, the handle assembly 300 can also include a trigger 328 extending from the housing 302. The trigger 328 can include a proximal end 330 and a distal end 332. The proximal end 330 of the trigger 328 can be rotatably engaged with the housing 302 and the distal end 332 of the trigger 328 can be free. As such, the trigger 328 can rotate around the proximal end 330 of the trigger 328.

FIG. 4 further indicates that an arm 334 can extend from the trigger 328. The arm 334 can include a plurality of teeth 336 that can engage the teeth 318 formed on the ratchet wheel 316. The handle assembly 300 can also include a spring 338 installed around a post 340 within the housing 302. The spring 338 can bias the trigger 328 outward relative to the housing 302. In a particular embodiment, when the trigger 328 is squeezed inward relative to the housing 302, the arm 334 can rotate the ratchet wheel 316 and cause the carrier 312 to slide within the housing 302 toward the proximal end 304 of the housing 302.

In a particular embodiment, the stent delivery device 100 illustrated in FIG. 1 can be engaged with the handle assembly 300 shown in FIG. 5. Specifically, the body 102 of the stent delivery device 100 can be inserted within the carrier 312. Further, the inner carrier catheter, illustrated at 120 in FIG. 1, can be installed within the housing 302 of the handle assembly 300 so that the handle, illustrated at 128 in FIG. 1, extends through the proximal end 304 of the housing 302. The handle 128 of the inner carrier catheter 120 can be engaged with the housing 302 so that the handle 128 does not move relative to the housing during operation of the handle assembly 300.

Accordingly, the safety clip, illustrated at 140 in FIG. 1, can be removed from the stent delivery device 100 and the trigger 328 can be squeezed to move the carrier 312 within the handle assembly 300 toward the proximal end 304 of the housing 302. As the carrier 312 moves, the body 102 of the stent delivery device 100 can be moved toward the handle 128 of the inner carrier catheter 120. As the body 102 of the stent delivery device 100 moves toward the handle of the inner carrier catheter 120, the outer sheath, illustrated at 110 in FIG. 1, can slide off of the stent 126 and expose the stent 126 inside a patient.

DESCRIPTION OF A TWISTED STENT

Referring to FIG. 6 and FIG. 7, a stent is shown and is generally designated 600. As shown, the stent 600 can include a stent body 602. The stent body 602 can be hollow and generally cylindrical. Further, the stent body 602 can include a proximal end 609 and a distal end 606. The proximal end 609 can include a radiopaque band 608. The distal end 606 can also include a radiopaque band 610.

As indicated in FIG. 6 and FIG. 7, the stent body 602 can include a plurality of struts 612. Further, the struts 612 can establish a plurality of cells 614 within the stent body 602. The struts 612 can be in the form of an interconnected network or matrix that is generally continuous. The struts 612 can form a repeating pattern that can define an array of cells 614. The cells 614, as shown, can be closed. However, it is noted that the stent 600 may have localized areas in which other struts 612 do not form closed cells. In other words, the stent 600 can be a closed-cell stent in which each cell is separate from adjacent cells. Alternatively, the stent 600 can be an open-cell stent in which one or more struts between two or more adjacent cells is removed from the construction of the stent 600.

In a particular embodiment, as shown, each cell 614 can be hexagonally shaped. Alternatively, each cell 614 can be generally diamond shaped, generally elliptical, or another shape that can allow the stent 600 to be collapsed as described herein.

The stent 600 is movable between a collapsed configuration, shown in FIG. 6, and an expanded configuration, shown in FIG. 7. FIG. 6 and FIG. 7 show that the stent 600 can have a diameter 616. The diameter 616 of the stent 600, in the collapsed configuration, is relatively smaller than the diameter 616 of the stent 600 in the expanded configuration. In the collapsed configuration, the cells 614 within the stent body 602 can be collapsed. Further, in the expanded configuration the cells 614 within the stent body 602 can be expanded.

Referring to FIG. 7, the stent 600 can include a longitudinal axis 622. Further, each cell 614 can include a minor axis 618 and a major axis 620. Each cell 614 can include a minor length along the minor axis 618 and a major length along the major axis 620. Moreover, each cell 614 can have an aspect ratio defined by the ratio of the minor length to the major length, when the stent 600 is expanded as shown in FIG. 7. In a particular embodiment, the aspect ratio of each cell 614 can be less than or equal to one (1). In another embodiment, the aspect ratio of each cell 614 can be approximately three-quarters (0.75). In yet another embodiment, the aspect ratio of each cell 614 can be approximately one-

half (0.5). In still another embodiment, the aspect ratio of each cell 614 can be approximately one-quarter (0.25).

The major axis 620 of each cell 614 can be angled with respect to the longitudinal axis 622 to establish a cell angle 624, β. In a particular embodiment, β can be greater than zero degrees and less than ninety degrees ($0° < \beta < 90°$). In another embodiment, β can be greater than one degree and less than sixty degrees ($1° < \beta < 60°$). In yet another embodiment, β can be greater than two degrees and less than forty-five degrees ($2° < \beta < 45°$). In still another embodiment, β can be greater than five degrees and less than thirty degrees ($5° < \beta < 30°$).

The orientation of the cells 614 can allow the cells to form a helical pattern around the stent body 602 and can allow the stent 600 to be collapsed by grasping the ends of the stent 600 and rotating the ends with respect to each other. This means relative rotation with respect to both ends. For example, the proximal end 609 can be fixed and the distal end 606 can be rotated around the longitudinal axis 622. Further, the distal end 606 can be fixed and the proximal end 609 can be rotated around the longitudinal axis 622. Also, both ends can be rotated in opposite directions relative to each other around the longitudinal axis 622. As the ends of the stent 600 are rotated relative to each other, the cells 614 can collapse. As the cells 614 collapse, the stent 600 can collapse. Further, as the stent 600 collapses, the diameter 616 of the stent 600 can decrease substantially uniformly from an expanded diameter, DE, to a collapsed diameter, DC. In a particular embodiment, a ratio of DC to DE is approximately one-half (DC/DE = 0.5). In another embodiment, a ratio of DC to DE is approximately one-quarter (DC/DE = 0.25). In yet another embodiment, a ratio of DC to DE is approximately one-eighth (DC/DE = 0.125).

In a particular embodiment, the stent 600 can be made from a shape memory material. The shape memory material can include a shape memory polymer, a shape memory metal, or a combination thereof. Further, the shape memory metal can include a metal alloy. The metal alloy can include a nickel titanium alloy, e.g., nitinol. The stent 600 can particularly be made principally from, or even consist essentially of, nitinol.

In an alternative embodiment, the stent 600 can be made from a non-shape memory metal, e.g., stainless steel, titanium, a cobalt-chrome alloy, or a combination thereof. In such a case, the stent 600 can be balloon deployable. In other words, the stent can be installed over a balloon catheter. When the stent is in an appropriate location within a patient, a balloon on the balloon catheter can be inflated in order to expand the stent within the patient.

FIG. 8 illustrates a stent, e.g., the stent 600 described herein, installed on the inner carrier catheter, e.g., the inner carrier catheter 120 described herein. FIG. 8 shows the stent 600 installed over the stent engagement area 200 of the inner carrier catheter 120. As shown, the helical pattern established by the stent cells 614 is arranged so that it is opposite the helical structure 202 within the stent engagement area 200. Accordingly, the helical structure 202 can engage the stent 600 and

substantially prevent the stent 600 from rotating on the inner carrier catheter 120 during installation and deployment of the stent.

DESCRIPTION OF A METHOD OF FORMING A STENT

Referring to FIG. 9, a method of forming a stent is shown and commences at block 900. At block 900, the proximal end of the stent can be grasped. At block 902, the distal end of the stent can be grasped. In a particular embodiment, the ends of the stent can be grasped by a mechanical gripping device. Alternatively, a user can grasp the ends of the stent with his or her fingers.

Moving to block 904, the proximal end of the stent can be rotated relative to the distal end of the stent in order to move the stent to a collapsed configuration. In a particular embodiment, the proximal end of the stent can be rotated in a first direction relative to a longitudinal axis, e.g., clockwise, and the distal end of the stent can be rotated in a second direction relative to the longitudinal axis opposite the first direction, e.g., counterclockwise. In a particular embodiment, the stent can be formed with a plurality of helically arranged cells, as described herein. As the ends of the stent are rotated, the cells can collapse and the stent can collapse.

Continuing to block 906, after the stent is moved to a collapsed configuration, the stent can be installed over a carrier catheter while in the collapsed configuration. Thereafter, at block 908, an outer sheath can be installed over the carrier catheter and the stent. The method can then end at block 910.

In a particular embodiment, a chilling agent, e.g., liquid nitrogen, can be applied to the stent before it is collapsed. Cooling the stent before, or as, the stent is collapsed can aid in collapsing the stent and can substantially prevent the stent from springing outward and expanding when a collapsing force is removed from the stent.

CONCLUSION

With the configuration of embodiments described above, the twisted stent as disclosed herein provides a device that can be used to treat a stenosis. According to an embodiment, the twisted stent includes a stent body having a plurality of cells arranged in a helical pattern around the stent body. The twisted stent can be relatively easily collapsed by grasping the ends of the twisted stent and rotating the ends in opposite directions. As the ends of the stent are rotated, the helical arrangement of the cells allows the cells to collapse. As the cells collapse, the stent collapses. Embodiments provide stent configurations that have superior reduced profiles.

The above-disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover all such modifications, enhancements, and other embodiments that fall within the true spirit and scope of the present invention. Thus, to the maximum extent allowed by law, the scope of the present invention is to be determined by the broadest permissible interpretation

of the following claims and their equivalents, and shall not be restricted or limited by the foregoing detailed description.

CLAIMS:

1. A stent, comprising:
a stent body having a longitudinal axis, the stent body having a network of struts defining a plurality of cells defined between interconnected struts, wherein each of the plurality of cells includes a major axis that is angled with respect to the longitudinal axis to form a cell angle, β.

2. The stent of claim 1, wherein β is greater than zero degrees and less than ninety degrees ($0° < \beta < 90°$).

3. The stent of claim 2, wherein β is greater than one degree and less than sixty degrees ($1° < \beta < 60°$).

4. The stent of claim 3, wherein β is greater than two degrees and less than forty-five degrees ($2° < \beta < 45°$).

5. The stent of claim 4, wherein β is greater than five degrees and less than thirty degrees ($5° < \beta < 30°$).

6. The stent of claim 1, wherein the stent body defines a distal end and proximal end, wherein the stent body includes an outer diameter, and wherein the stent is configured so the outer diameter decreases as the distal end and the proximal end are rotated with respect to each other about the longitudinal axis.

7. The stent of claim 1, wherein the stent comprises a shape memory material.

8. The stent of claim 7, wherein the shape memory material comprises a shape memory polymer.

9. The stent of claim 7, wherein the shape memory material comprises a shape memory metal.

10. The stent of claim 9, wherein the shape memory metal comprises a nickel titanium alloy.

11. The stent of claim 1, wherein the stent is a closed-cell stent.

12. The stent of claim 1, wherein the stent is an open-cell stent.

13. The stent of claim 1, wherein the stent comprises a non-shape memory material.

14. The stent of claim 13, wherein the non-shape memory material comprises stainless steel, titanium, a cobalt-chrome alloy, or a combination thereof.

15. A stent, comprising:
a stent body having a proximal end and distal end, the stent body having a longitudinal axis, wherein the stent is configured to collapse radially about the longitudinal axis as the proximal end is rotated with respect to the distal end.

16 The stent of claim 15, wherein the stent collapses substantially uniformly.

17. The stent of claim 15, wherein the stent body comprises a plurality of struts and a plurality of cells established between the struts.

18. The stent of claim 17, wherein each cell is generally hexagonal.

19. The stent of claim 18, wherein the stent includes a longitudinal axis and wherein each cell includes a major axis that is angled with respect to the longitudinal axis.

20. The stent of claim 19, wherein the plurality of cells form a helix around the stent body.

21. A method of preparing a stent for deployment, the stent having a proximal end and a distal end, the method comprising:
grasping the proximal end of the stent;
grasping the distal end of the stent; and
rotating the proximal end and the distal end with respect to each other to move the stent to a collapsed configuration.

22. The method of claim 21, further comprising:
installing the stent in the collapsed configuration over a carrier catheter.

23. The method of claim 22, wherein the carrier catheter includes a stent engagement area.

24. The method of claim 23, wherein the stent engagement area includes a helical structure.

25. The method of claim 24, wherein the stent includes a helical cell pattern established in a direction opposite to the helical structure.

26. A stent delivery tool, comprising:
an inner carrier catheter, wherein the inner carrier catheter includes a stent engagement area configured to engage a twisted stent and prevent the twisted stent from rotating relative to the inner carrier catheter.

27. The stent delivery tool of claim 26, wherein the stent engagement area includes a helical structure extending at least partially along the stent engagement area.

28. The stent delivery tool of claim 27, wherein the helical structure comprises a helical groove.

29. The stent delivery tool of claim 27, wherein the helical structure comprises a raised helical rib.

30. The stent delivery tool of claim 27, wherein the helical structure is angled with respect to a longitudinal axis of the inner carrier catheter to form a stent engagement angle, α.

31. The stent delivery tool of claim 30, wherein α is greater than zero degrees and less than ninety degrees ($0° < \alpha < 90°$).

32. The stent delivery tool of claim 31, wherein α is greater than one degree and less than sixty degrees ($1° < \alpha < 60°$).

33. The stent delivery tool of claim 32, wherein α is greater than two degrees and less than forty-five degrees ($2° < \alpha < 45°$).

34. The stent delivery tool of claim 33, wherein α is greater than five degrees and less than thirty degrees ($5° < \alpha < 30°$).

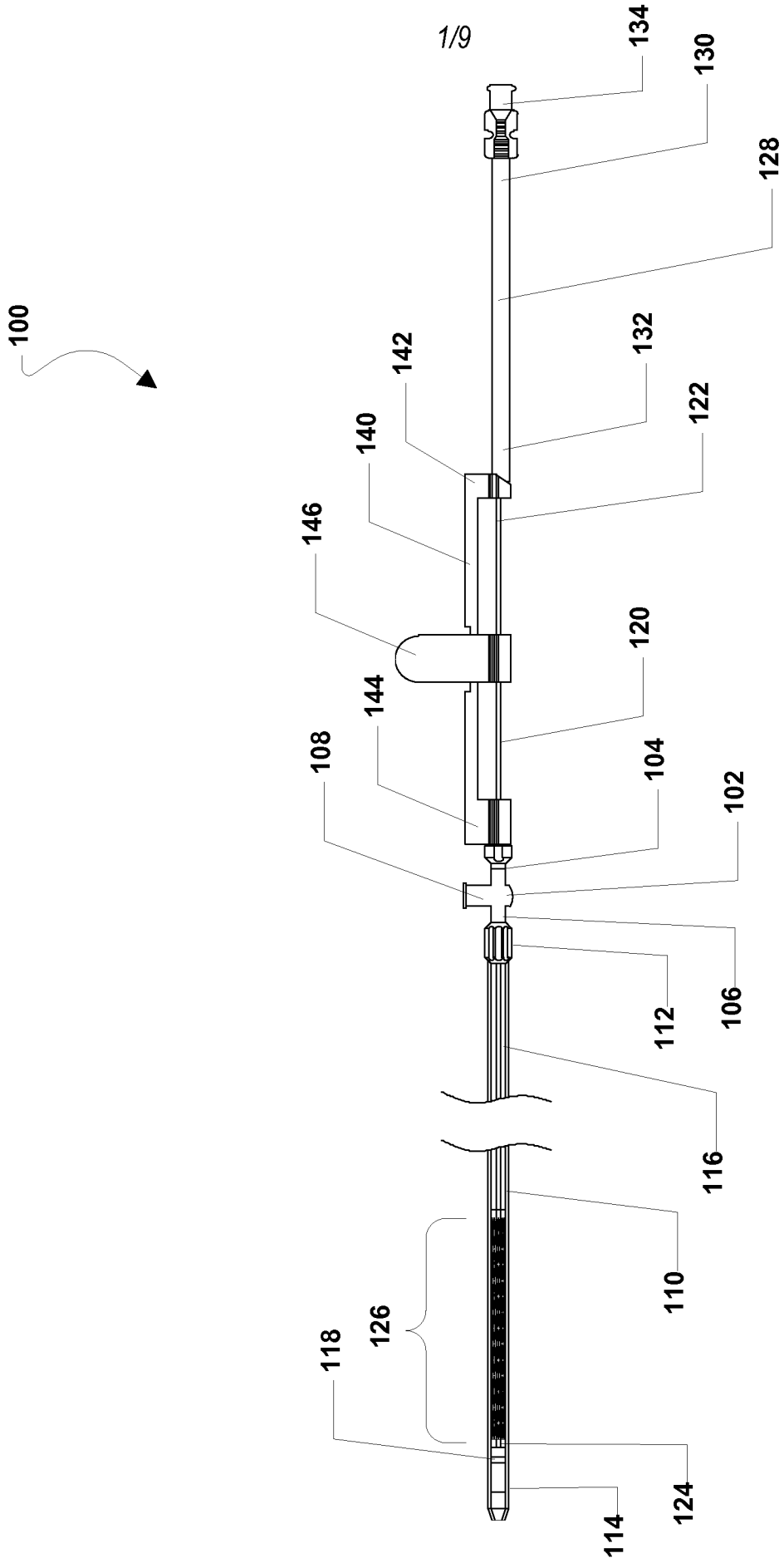
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FIG. 1

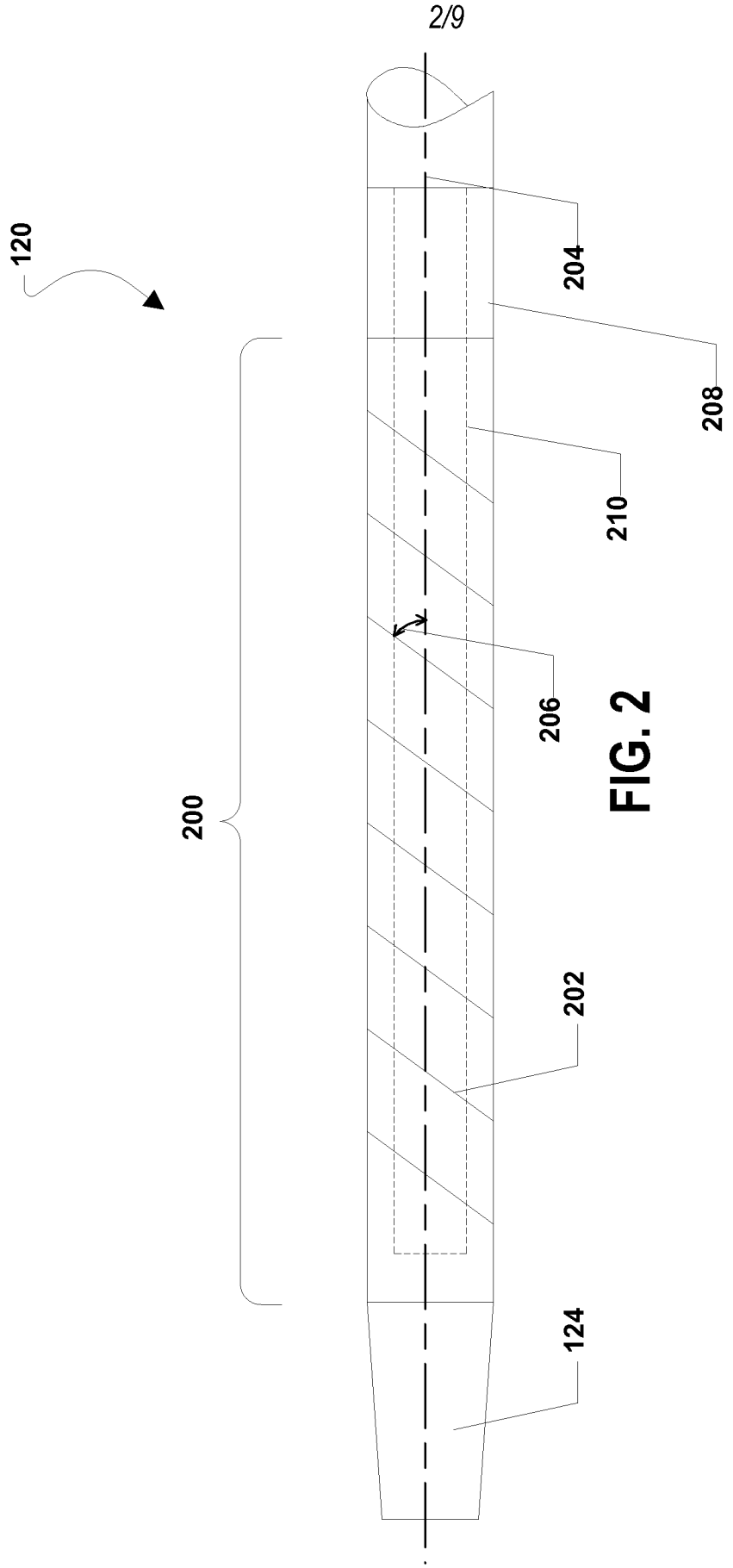
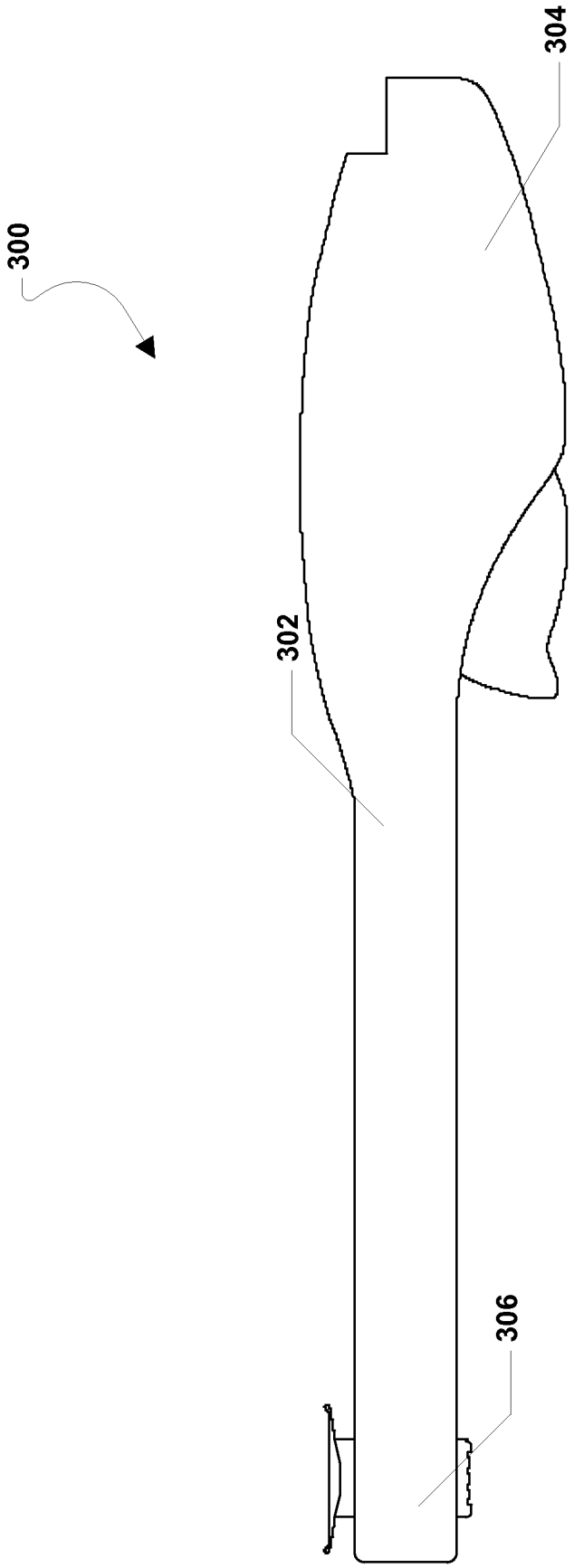


FIG. 2



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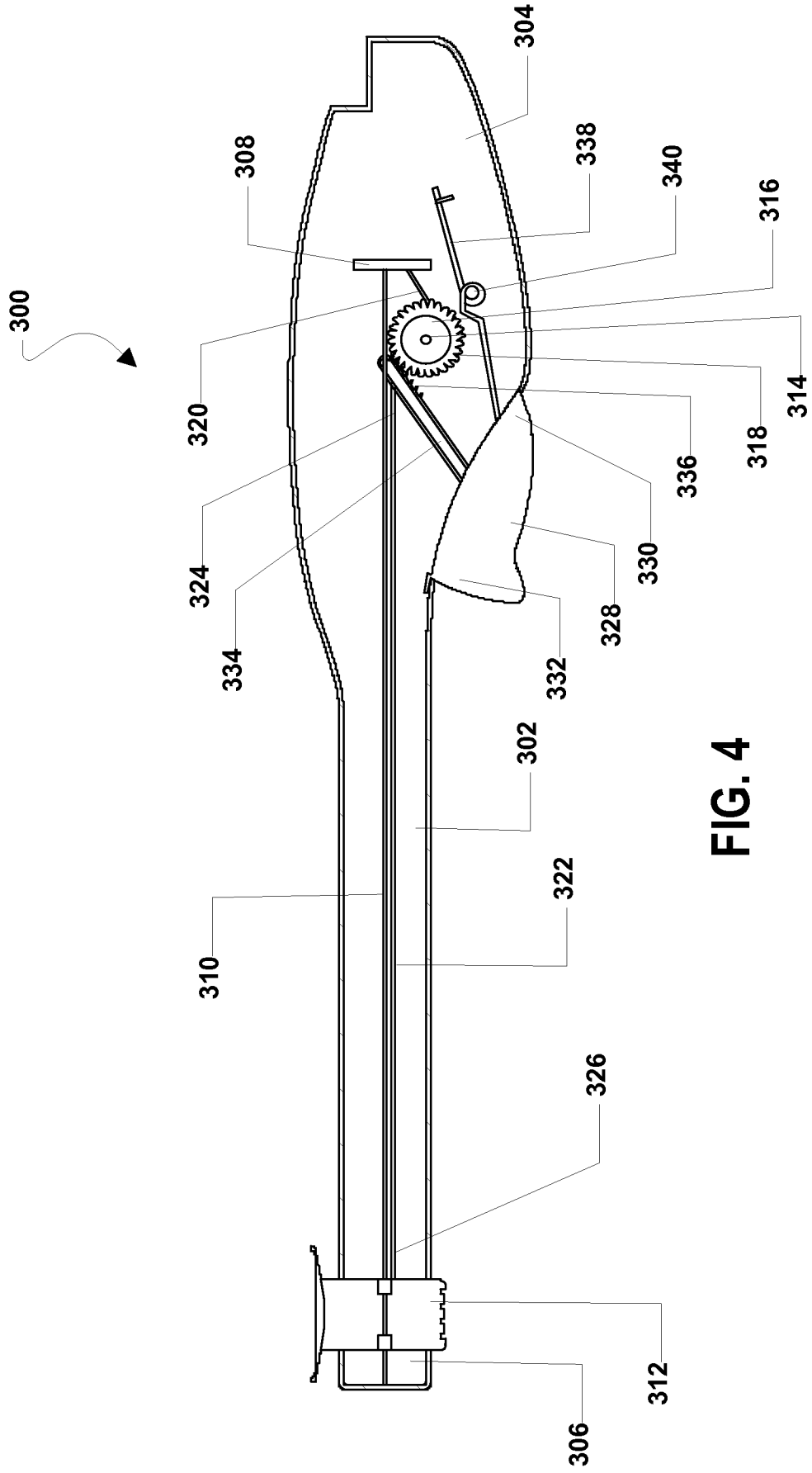
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FIG. 4

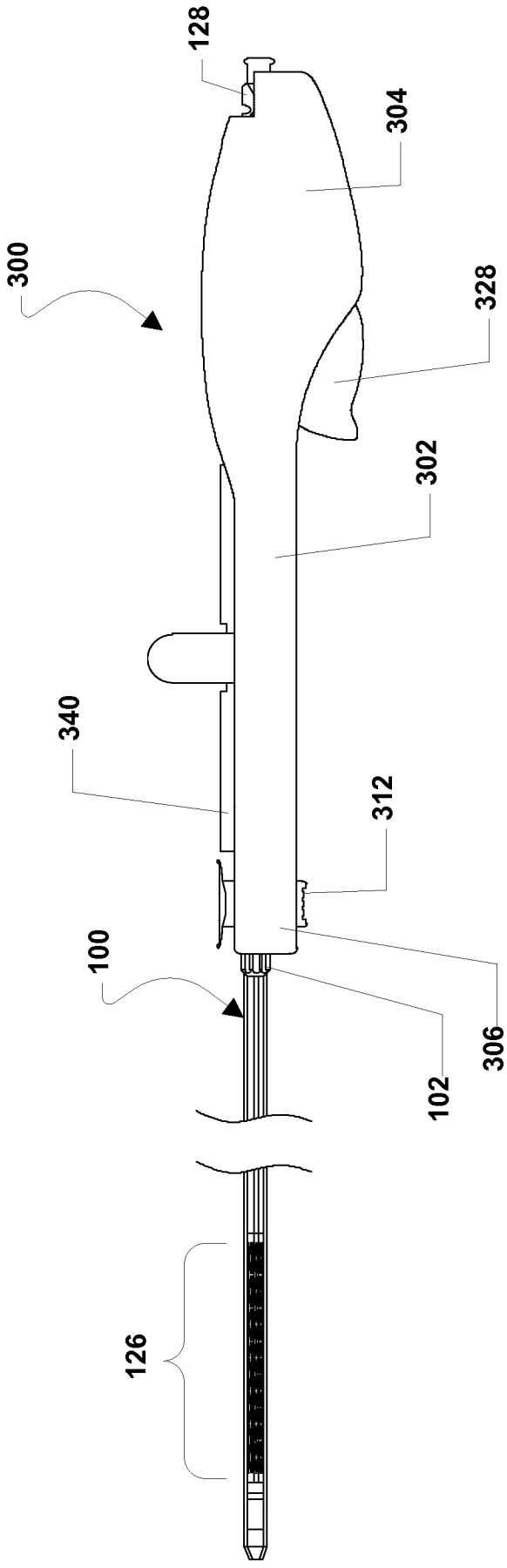

FIG. 5

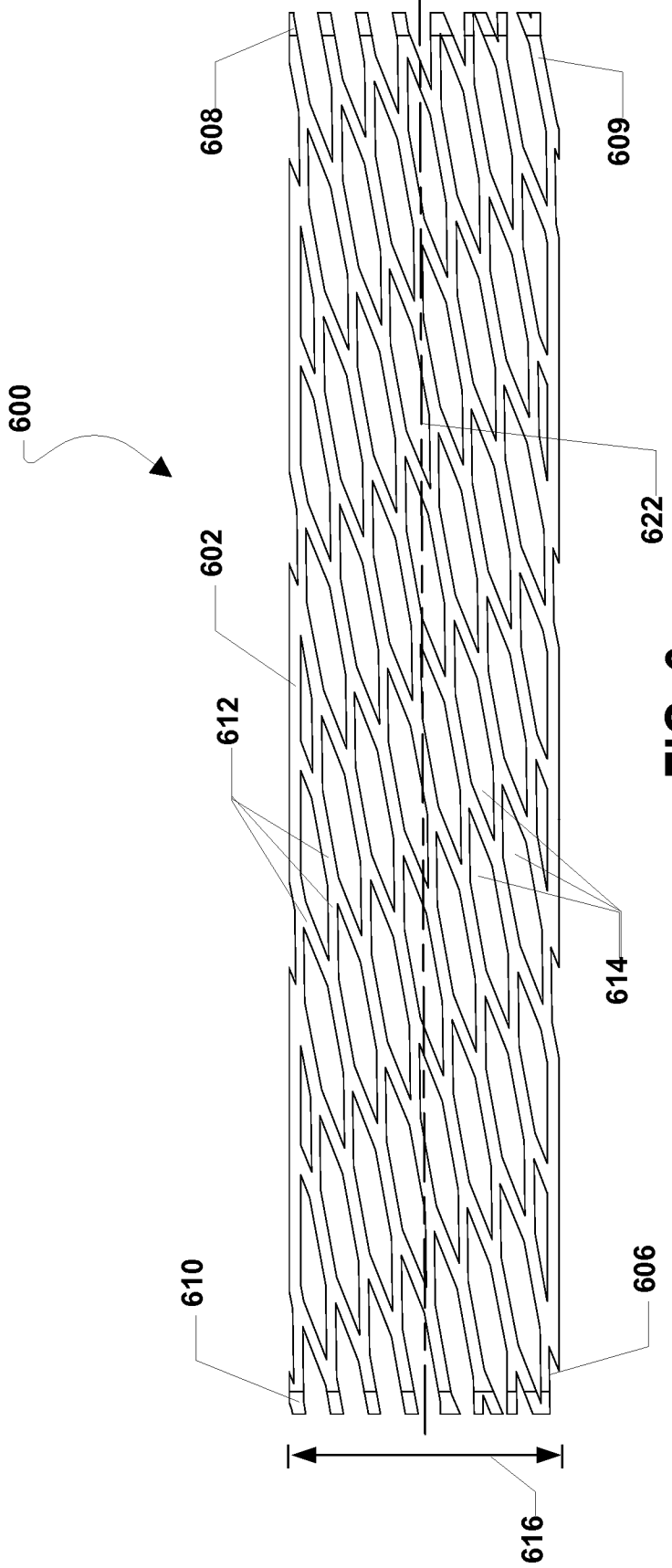

FIG. 6

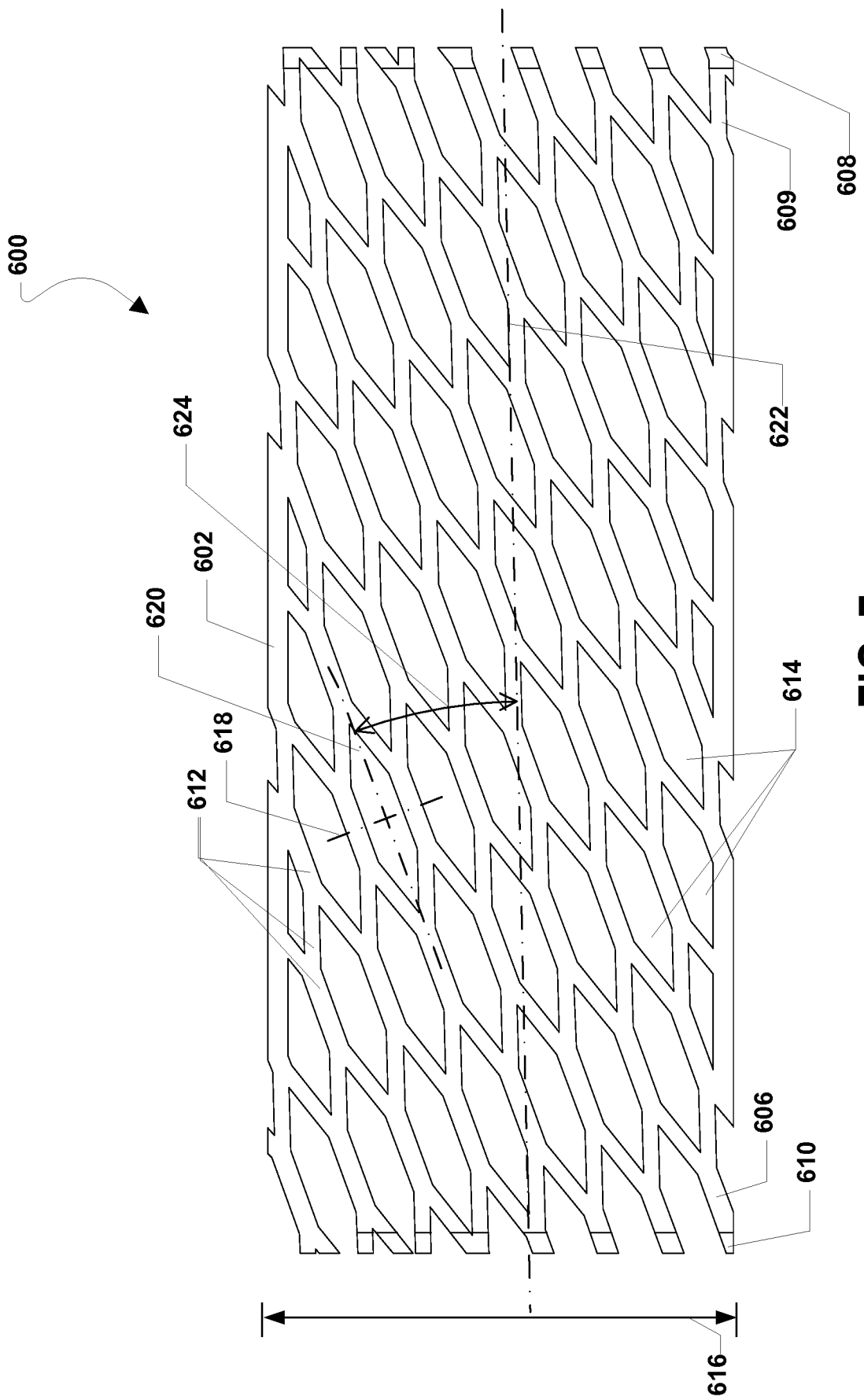

FIG. 7

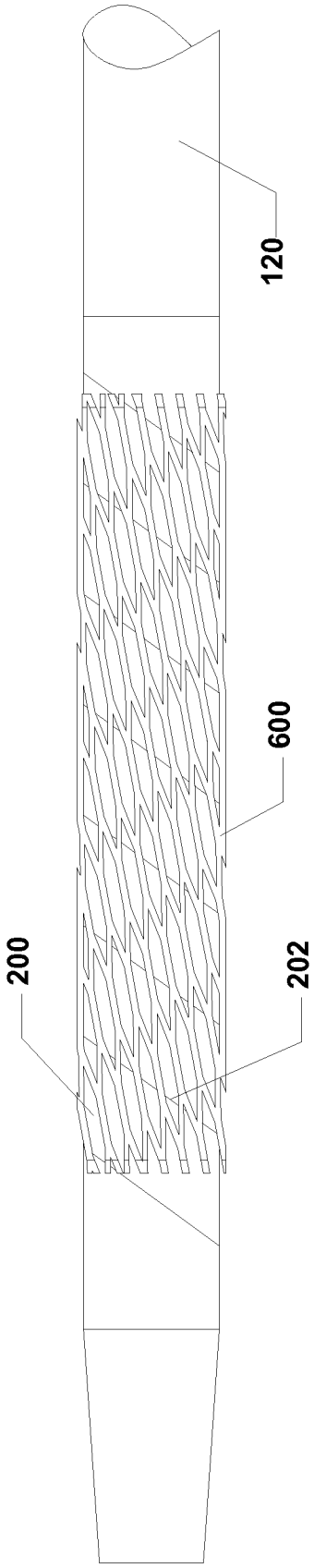

FIG. 8

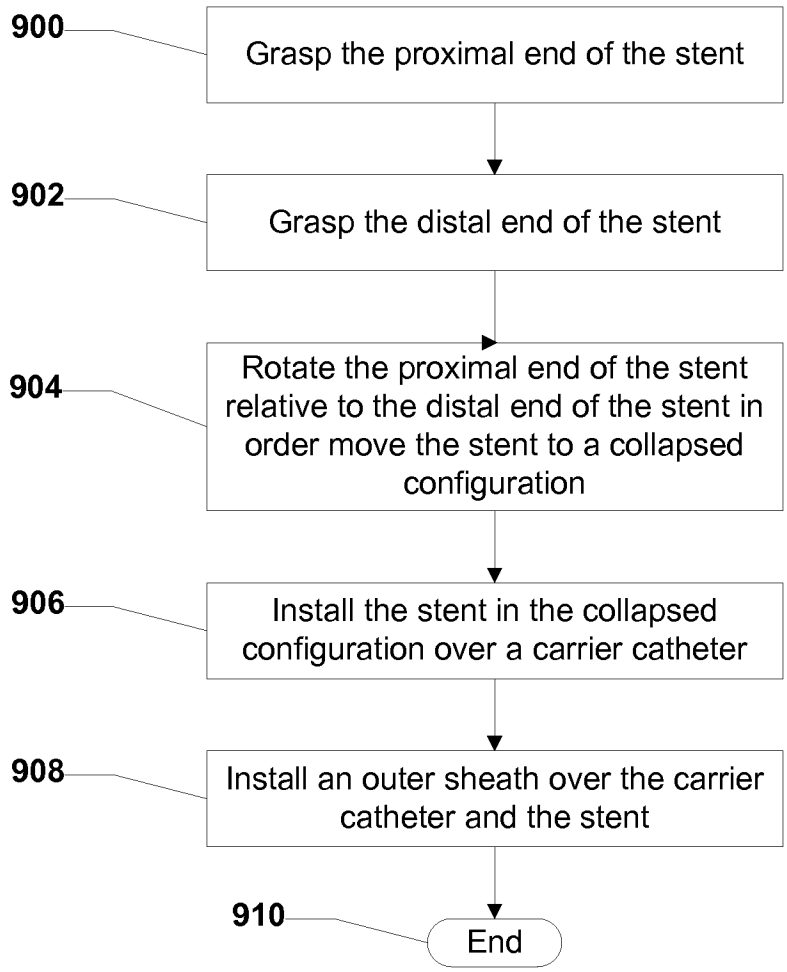
900
Grasp the proximal end of the stent
902
Grasp the distal end of the stent
904
Rotate the proximal end of the stent relative to the distal end of the stent in order move the stent to a collapsed configuration
906
Install the stent in the collapsed configuration over a carrier catheter
908
Install an outer sheath over the carrier catheter and the stent
910
End

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/064728

A. CLASSIFICATION OF SUBJECT MATTER

A61F 2/06(2006.01)i, A61F 2/84(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 A61F 2/06

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

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

eKIPASS, NCBI PubMed database, Delphion Researh Intellectural Property Network database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 20040111147 A1 (Rabkin et al.) Jun. 10, 2004. See the Figure 1-12.	15-18 and 21-29 1-14, 19, 20 and 30-34
A	US 20060111771 A1 (Ton et al.) May 25, 2006. See the whole document.	1 - 34
A	US 6,488,702 B1 (Besselink) Dec. 3, 2002. See the whole document.	1 - 34
A	US 6,451,052 B1 (Burmeister et al.) Sep. 17, 2002. See the whole document.	1 - 34
A	US 5,938,697 A (Killion et al.) Aug. 17, 1999. See the whole document.	1 - 34

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 OCTOBER 2008 (29.10.2008)	**29 OCTOBER 2008 (29.10.2008)**

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Facsimile No. 82-42-472-7140

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JEONG Eui Jun
Telephone No. 82-42-481-5549

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2008/064728

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