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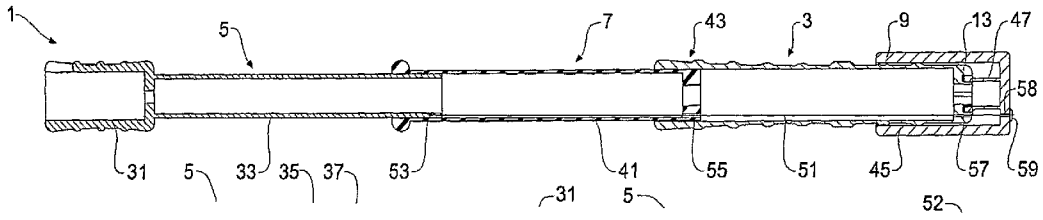

(57) Abstract: A stent graft introducer actuation assembly (1) having a fixed handle (3) and at least one sliding handle (5, 7), the sliding handle or handles (5, 7) telescoping within the fixed handle (3), and a winch arrangement (9, 47, 51, 92) to retract the sliding handle (5, 7) into the fixed handle (3).

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HANDLE FOR A DEPLOYMENT DEVICE

Description

Technical Field

This application relates to a stent graft introducer actuation assembly, and in particular to a rotary handle for a controlled sequential deployment device. Furthermore, this application relates to a controlled sequential deployment device for endovascular stent grafts and more particularly to a method of actuation of such a device.

Background of the Invention

In PCT Patent Publication No. WO 98/53761 entitled "A Prosthesis And A Method Deploying A Prosthesis" the present applicant discloses an introducer for a stent graft that retains the stent graft so that each end can be moved independently during the process of endovascular deployment of the stent graft. This device requires that a number of actions be taken in a particular consecutive order to place a stent graft in the required position in the vasculature. One end of the stent graft is released, then another end of the stent graft is released. If required, between the release of each of the ends, a branch stent graft from a side arm of the stent graft is placed. These features and other features disclosed in PCT Patent Publication No. WO 98/53761 are incorporated herewith in their entirety into this specification.

It is desirable that the set of sequential actions necessary to release the stent graft at the desired position in the vasculature be undertaken in the required order and that there be less chance for operator error during such a deployment.

In US Provisional Patent Application Serial No 60/795,617, the present applicant discloses a device for the controlled sequential deployment of a stent graft into the vasculature of a patient. The device includes at least one telescoping slide which assists in drawing back the sheath from a stent graft and release stent graft retention wires.

It has been found, however, that a significant load is provided by a stent graft that includes self expanding stents engaging against the inner surface of the

sheath and trigger wires retaining the graft onto the pusher. This is increased by the general friction of interacting components.

The subject matter of this application aims to address one or more of the above problems.

Summary of the Invention

According to a first aspect of the present invention, there is provided a stent graft introducer actuation assembly, including a fixed handle and a sliding handle, the fixed handle and the sliding handle being in a telescoping arrangement so that one handle is able to slide within the other, sheath connecting means attached to the distal end of the sliding handle, and a winch arrangement to retract the sliding handle with respect to the fixed handle thereby to withdraw a sheath from a stent graft.

Preferably the winch arrangement includes a ratchet arrangement to allow deployment of the winch arrangement only in a retraction direction.

In a preferred embodiment the winch arrangement includes a winch drum, a rotation handle for the winch drum and a cable extending from the winch drum to the sliding handle.

The winch drum can be mounted on an axis transverse to the longitudinal extent of the actuation assembly or alternatively the winch drum can be mounted on an axis parallel to the longitudinal extent of the actuation assembly.

Hence, in one embodiment the winch arrangement comprises a winch drum, a rotation handle for the winch drum and a cable extending from the winch drum to the sliding handle, the winch drum and rotation handle rotating on a longitudinal axis parallel to or coaxial with the longitudinal extent of the actuation assembly.

Preferably, the winch drum comprises a tapered body to provide an initial mechanical advantage in use.

Preferably, the cable is passed around a pulley, protrusion or boss in the sliding handle and returned to the fixed handle to provide a mechanical advantage in use.

The cable can include a band or ribbon of relatively inextensible material or a wire, such as a twisted or braided wire cable.

Preferably the actuation assembly includes the fixed handle, a release portion and the sliding handle in a telescoping arrangement, the release portion able to slide in a telescoping manner with respect to the fixed handle and the sliding handle able to slide in a telescoping manner with respect to the release portion.

The actuation assembly can include a first removable stop pin to prevent movement of the sliding handle with respect to the release portion and a second removable stop pin to prevent movement of the release portion with respect to the fixed handle. It may also include a third removable stop pin acting between the fixed handle and the release portion to restrict the distance of retraction of the release portion with respect to the fixed handle until the third stop pin is removed.

The fixed handle can include a first grip and the sliding handle can include a second grip.

According to a second aspect of the present invention there is provided a stent graft introducer actuation assembly, the introducer including a pusher, a stent graft releasably retained onto the pusher, a sheath coaxially around the pusher and enclosing the stent graft and a sheath hub to which the sheath is mounted, the actuation assembly including a fixed handle and a sliding handle, the sliding handle telescoping within the fixed handle, the sheath hub being retained to the sliding handle and the pusher extending from the fixed handle through the sliding handle, and a winch arrangement to retract the sliding handle into the fixed handle thereby to withdraw the sheath from the stent graft.

According to a third aspect of the present invention, there is provided, an actuation assembly for a stent graft introducer, the introducer including a pusher, a stent graft releasably retained onto the pusher, a sheath coaxially around the pusher and enclosing the stent graft and a sheath hub to which the sheath is mounted, the actuation assembly including a fixed handle, a release portion and a sliding handle, the release portion telescoping within the fixed handle and the

sliding handle telescoping within the release portion, the sheath hub being retained to the sliding handle and the pusher extending from the fixed handle through the sliding handle, and preferably thorough the release portion, a winch arrangement to retract the sliding handle and release portion into the fixed handle to thereby withdraw the sheath from the stent graft, a first removable stop pin to prevent movement of the sliding handle with respect to the release portion and a second removable stop pin to prevent movement of the release portion with respect to the fixed handle, a third removable stop pin acting between the fixed handle and the release portion to restrict the distance of retraction of the release portion into the fixed handle until the third removable stop pin is removed, the winch arrangement comprising a winch drum, rotation handle for the winch drum and a cable extending from the winch drum to and affixed to the sliding handle, the winch drum and rotation handle rotating on a longitudinal axis parallel to or coaxial with the longitudinal extent of the actuation assembly and the cable comprising a band or ribbon of relatively inextensible material.

According to a fourth aspect of the present invention, there is provided a stent graft introducer actuation assembly including a fixed handle and a sliding handle, the sliding handle telescoping within the fixed handle, the sheath hub being retained to the sliding handle and the pusher extending from the fixed handle through the sliding handle, and a winch arrangement to retract the sliding handle into the fixed handle to thereby withdraw the sheath from the stent graft.

According to a fifth aspect of the present invention, there is provided a stent graft introducer actuation assembly including a fixed handle, a release portion and a sliding handle, the release portion telescoping within the fixed handle and the sliding handle telescoping within the release portion, a winch arrangement to retract the sliding handle and release portion into the fixed handle, a first removable stop pin to prevent movement of the sliding handle with respect to the release portion and a second removable stop pin to prevent movement of the release portion with respect to the fixed handle, a third removable stop pin acting between the fixed handle and the release portion to restrict the distance of retraction of the release portion into the fixed handle until the third removable

stop pin is removed, the winch arrangement including a winch drum, a rotation handle for the winch drum and a cable extending from the winch drum to and affixed to the sliding handle, the winch drum and rotation handle rotating on a longitudinal axis parallel to or coaxial with the longitudinal extent of the actuation assembly and the cable comprising a band or ribbon of relatively inextensible material.

According to a sixth aspect of the present invention there is provided a stent graft introducer including a pusher, a stent graft releasably retained onto the pusher, a sheath coaxially around the pusher and enclosing the stent graft, a sheath hub to which the sheath is mounted, and an actuation assembly as described above.

Throughout this specification the term distal with respect to a portion of the aorta, a deployment device or a prosthesis is the end of the aorta, deployment device or prosthesis further away in the direction of blood flow away from the heart and the term proximal means the portion of the aorta, deployment device or end of the prosthesis nearer to the heart. When applied to other vessels similar terms such as caudal and cranial should be understood.

Brief Description of the Drawing

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a side view of first embodiment of a stent graft retraction device according to a first embodiment;

Figure 2 shows a longitudinal cross-sectional view of the device shown in Figure 1;

Figures 3A, 3B and 3C show a side view and cross-sectional view of a first slide component of the stent graft retraction device of Figure 1 and a detailed view of the connection of the winch cable to the first slide;

Figures 4A and 4B show a top view and cross-sectional view of the second slide component of the stent graft retraction device of Figure 1;

Figures 5A and 5B show a top view and a cross-sectional view of a rotary handle portion of the stent graft stent graft retraction device of Figure 1;

Figures 6A and 6B show a top view and a cross-sectional view of the fixed handle portion of the stent graft retraction device of Figure 1;

Figures 7A to 7E show the various stages of operation of the stent graft introducer actuation assembly of Figure 1 and Figure 2;

Figure 8 shows a perspective view of a stent graft introducer and actuation handle assembly according to the embodiment shown in Figure 1;

Figures 9A to 9C show the various stages of operation of another embodiment of a stent graft introducer actuation assembly;

Figure 10 shows another embodiment of a stent graft introducer actuation assembly;

Figures 11 and 11A show another embodiment of a stent graft introducer actuation assembly according to the present invention and its method of operation; and

Figure 12 shows a longitudinal cross-sectional view of the actuation assembly of Figures 1 to 6 with a stent graft introducer carried in it.

Detailed Description

Referring in particular to Figures 1 to 6 it can be seen that the stent graft introducer actuation assembly 1 comprises generally a fixed handle 3, a first slide or sliding handle 5 and a second slide or release portion 7. On the fixed handle 3 is a rotary handle 9.

The fixed handle 3 as shown in details in Figures 6A and 6B comprises an elongate tubular body 11 with a closed distal end 13. Hand grips 15 are provided on the outside of the fixed handle 3.

A toothed ring 17 is moulded into the outer surface of the fixed handle 3, the use of which will be discussed later. An annular groove 19 in the distal closed end 13 acts as a support for a winch drum which is integral with the rotary handle 9 as will be discussed later. An aperture 21 is provided for a removable second stop pin and aperture 23 is for a third removable stop pin as will be discussed later.

First slide 5 as shown on detail in Figures 3A and 3B includes a socket 31 for the hub of a sheath manipulator of a stent graft as will be discussed in relation

to Figure 8. The first slide 5 includes an elongate tubular body 33 with a groove 35 along it into which is engaged a pin (not shown) which prevents relative rotation of the first slide 5 and the second slide 7. Apertures 37 provides an original locking arrangement to prevent movement of the first slide 5 with respect to the second slide 7 until it is required. The selection of which aperture 37 is used depends upon the length of a stent graft deployed using the device of the present invention.

Connection of the cable 51 to the first slide is shown in the detail drawing Figure 3C. A groove 34 is formed in the wall of the tubular body 33 of the first slide 5 and the groove terminates in a through aperture 32. The cable 51 has a blob of solder or other protrusion 52 formed at its proximal end and the blob 52 is received in the through aperture 32 and the cable 51 lies in the groove 34.

The second slide 7 as shown on detail in Figures 4A and 4B includes an elongate tubular body 41 which slides inside the fixed handle 3. The body 41 has a closed distal end 43. The first slide 5 slides within the second slide 7.

The rotary handle 9 as shown on detail in Figures 5A and 5B comprises a tubular body 45 which fits over the distal end of the fixed handle 3. Within the tubular body 45 of the rotary handle 9 is a integral winch drum 47 which is formed on the back wall 49 of the rotary handle 9. The winch drum has a bearing protrusion 51 which when mounted to the fixed handle 3 engages in and is supported by the annular groove 19 in the end 13 of the fixed handle 3 as shown in Figure 6B. A ratchet assembly 46 mounted into the rotary handle 9 has a detent pin 48 which in use engages into the toothed ring 17 (see Figure 6A) moulded into the outer surface of the fixed handle 3 such that the rotary handle can only be rotated in one direction. The detent pin 48 also assists in holding the rotary handle 9 engaged onto the fixed handle 3.

As can be particularly seen in the cross sectional view, Figure 2, a cable or inextensible band 51 is mounted at one end to the outer surface of the tubular body 33 of the first slide 5 at position 53 as discussed above in relation to Figure 3C. The cable extends through an aperture 55 in the rear surface 43 of the second slide 7. The cable then passes through an aperture 57 in the distal end

13 of the fixed handle 3 before extending past the winch drum 47 and then extending through aperture 58 in the rotary handle and being fastened at 59 to the rotary handle 9.

The operation of the winch actuated controlled sequential deployment actuator of one embodiment of the present invention is shown in Figures 7A to 7E.

Figure 7A shows the same as Figure 2 except that the winch drum 47 on the rotary handle 9 is shown not in cross-section to more clearly show how it is used. In these views the stent graft deployment device with which the actuation assembly is used is not shown.

As shown in Figure 7B the rotary handle 9 has been turned through about one turn and the cable 51 has been drawn around the winch drum 47 because it is fixed at 59 and passes through the aperture 57 in the fixed handle 3. A catch arrangement between the fixed handle 3 and the second slide 7 (not shown) prevents movement of these two items until the first slide 5 has been fully retracted and hence at this stage only the first slide 5 is retracted.

With continued rotation of the rotary handle 9 with respect to the fixed handle 3 as shown in Figure 7C, more cable 51 has wound on to the drum 47 and the first slide 5 has fully retracted into the second slide 7. At this stage the catch arrangement (not shown) is released so that the second slide can move in respect to the fixed handle 3.

As shown in Figures 7D and 7E, continued rotation of the rotary handle 9 with respect to the fixed handle 3 winds more cable 51 onto the drum 47 and the first and the second slides 5 and 7 respectively move into the fixed handle 3.

It will be seen therefore that by holding the fixed handle 3 stationary and rotating the rotary handle 9 the cable 51 is caused to wind onto the winch drum 47 and this causes the first and second slides to be withdrawn into the fixed handle 3.

Figure 8 shows the assembly of a controlled sequential actuation device according to the embodiment shown in Figures 1 to 6 with a stent graft deployment device mounted into it. The actuation device includes a fixed handle

103 with a first slide 105, a second slide 107 and a rotary handle 109. A first removable stop pin 60 prevents relative movement of the first slide 105 in respect to the second slide 107 until it is removed. A second removable stop pin 62 prevents relative movement of the second slide 107 into the fixed handle 103. A third removable stop pin 64 prevents complete retraction of the second slide 107 into the fixed handle 103 until it is removed.

The stent graft introducer mounted onto the actuation assembly includes a hub assembly 70, a sheath 72 mounted onto the hub and a nose cone dilator 74. The stent graft to be introduced is retained in the region 76 underneath the sheath 72. A main pusher catheter (not shown) of the stent graft introducer extends from the fixed handle 103 to distal of the stent graft in the region 76 just distal of the nose cone dilator 74. The hub 70 of the sheath manipulator is mounted into the socket 31 by means of a bayonet clip arrangement 78.

Rotation of the rotary handle 109 in respect of the fixed handle 103 causes the sheath 72 to be retracted distally from the nose cone dilator to expose and release the stent graft 76.

Figures 9A to 9C show in cross sectional view an alternative embodiment of actuation assembly for stent graft introducer. In these views the stent graft deployment device with which the actuation assembly is used is not shown.

In this embodiment the actuation assembly 80 includes a fixed handle 82, a first slide 84 and a second slide 86. In the fixed handle 82 there is an interior recesses 88 into which is mounted a winch drum 90 actuated by handle 92. A cable 94 is mounted to the winch drum 90 and extends forward to be mounted at 96 in the first slide 84.

In a similar manner to that explained in relation to Figure 7, rotation of the winch handle causes the cable 94 to be wound onto the winch drum 90 so that the first slide 84 is retracted into the second slide 86 and then as shown in Figure 9B the first and second slides are retracted into the fixed handle 82 until both slides are fully retracted as shown in Figure 9C.

Figure 10 shows another embodiment of a stent graft introducer actuation assembly. In this embodiment the same reference numerals as used in relation to

Figures 1 to 6 are used for corresponding items.

The stent graft introducer actuation assembly 100 of this embodiment comprises generally a fixed handle 3, a first slide 5 and a second slide 7. On the fixed handle 3 is a rotary handle 9. To give additional mechanical advantage to the winch arrangement 102 on the rotary handle 9 the cable 104 extends from its fixing point 106 on the rotary handle to a boss or pulley on the first slide 5 and then back to a fixing 110 on the end piece 13 of the fixed handle 3. Rotation of the rotary handle 9 will give an increased mechanical advantage to retraction of the slides.

Figures 11 and 11A show another embodiment of a stent graft introducer actuation assembly and its method of operation. In this embodiment the same reference numerals as used in relation to Figures 1 to 6 are used for corresponding items.

The stent graft introducer actuation assembly 120 of this embodiment comprises generally a fixed handle 3, a first slide 5 and a second slide 7. On the fixed handle 3 is a rotary handle 9. To give additional mechanical advantage to the winch arrangement 102 on the rotary handle 9 the winch drum 122 is tapered to give a reduced diameter 126 where the cable 124 first winds onto the winch drum. This means that additional turns are necessary to retract the slides early on in retraction of the first slide into the second slide which will give an increased mechanical advantage to the retraction where it is needed most due to greater friction.

Figure 12 shows a longitudinal cross-sectional view of the embodiment of the actuation assembly shown in Figures 1 to 6 with a stent graft introducer carried in it.

In this embodiment, the actuation assembly 1 comprises a handle portion 3, a first slide 5 and a second slide 7. The first slide 5 has a hub retention socket 31 and into this is received the hub 130 of a stent graft introduction assembly 132. A sheath 134 is mounted to the hub 130 and extends forward to a nose cone dilator 136. Just distal of the nose cone dilator and within the sleeve 134 a stent graft 138 is retained. A trigger wire 140 or a set of trigger wires engages

with the exposed stent 142 at the proximal end of the stent graft 138 and retains the proximal end of the stent graft to the stent graft introduction assembly 132. The trigger wire or wires extend distally through a lumen of the pusher catheter 144 to a trigger wire clamp 146 at the distal end of the second slide 7.

A method of retention of the proximal end of a stent graft onto an introducer is disclosed in PCT Publication WO03/101518 entitled "Trigger Wire System for a Prosthesis Deployment Device". This feature and other features disclosed in PCT Publication WO03/101518 could be used with the actuation assembly disclosed herein and the disclosure of PCT Publication WO03/101518 is herewith incorporated in its entirety into this specification.

The hub 130 is retained in the hub socket 31 on the first slide 5 by means of a bayonet lock arrangement as can be seen particularly in Figure 8.

The pusher catheter 144 extends back through the hub 130 to a mounting position 150 within the handle portion 3. The first slide 5 slides within the second slide 7 and a first removable stop pin 152 prevents relative movement of the first slide within the second slide until the locking pin 152 has been removed. The second slide 7 includes the trigger wire clamp 146 at the distal end thereof and a second removable stop pin 154.

A third removable stop pin 156 provides an intermediate stop position during withdrawal of the sheath 134 from the stent graft 138.

In a first stage of operation of the stent graft introducer actuation assembly according to this embodiment the first removable stop pin 152 is withdrawn so that the first slide 5 can slide within the second slide 7. As the hub 130 is connected to the first slide 5, the hub and therefore the sheath 134 is withdrawn from the nose cone dilator 136 so that the stent graft 138 is partially exposed. At this stage, the exposed stent 142 at the proximal end of the stent graft 138 is still retained just distal of the nose cone dilator 136.

In the next stage the first slide 5 continues to slide back inside the second slide 7 until the distal end of the first slide 5 is fully retracted into the second slide 7. The second removable stop pin 154 can then be removed, which enables the second slide 7 and first slide 5 to be able to slide into the handle portion 3.

At this stage, more of the stent graft 138 is exposed but the exposed stent 142 at the proximal end of the stent graft 138 is still retained just distal of the nose cone dilator 136.

Continued movement of the first slide 5 along with the second slide 7 within the handle portion 3 can occur until the distal end 157 of the second slide 7 engages third removable stop pin 156. During this stage, because the distal end of the trigger wire or wires 140 are clamped by the trigger wire clamp 146 on the distal end of the second slide 7, movement of the second slide 7 pulls the trigger wire 140 from its retention arrangement at the proximal end of the stent graft 138 so the proximal end of the stent graft is freed. At the same time, the sheath 134 has been withdrawn so that the distal end of the main body of the stent graft 138 is still retained within the sheath.

At this stage, a side arm can be deployed such as in relation to deployment about the aortic bifurcation by access from the contra-lateral iliac artery to engage an extension arm into the side arm 98. PCT Patent Publication No. WO 98/53761 discussed above describes how such a deployment can be carried out.

The third removable stop pin 156 can then be removed and the first and second slides continued in their movement back into the handle portion 3. Completion of the movement of the first and second slides 5 and 7 into the handle portion 3 ensures that the sheath 134 is completely withdrawn from the stent graft 138 and the stent graft 138 is released.

The hub 130 can then be released from the hub socket 31 on the first slide 5 so that the pusher 144 and nose cone dilator 136 can be withdrawn through the sleeve 134 along with the actuation assembly, leaving the hub and sheath in place. Subsequent deployment operations can be made through the sheath 134 and hub 130 as required.

It can be seen that by use of the described embodiments on an actuation assembly considerable mechanical advantage can be provided to retract the sheath of a stent graft introducer to assist with overcoming friction between the stent graft and a enclosing sheath.

The disclosures in United States patent application no. US 60/795,634 from which this application claims priority, and in the abstract accompanying this application are incorporated herein by reference.

Claims

1. A stent graft introducer actuation assembly (1), including a fixed handle (3) and a sliding handle (5, 7), the fixed handle and the sliding handle being in a telescoping arrangement so that one handle is able to slide within the other, sheath connecting means (31, 70) attached to the distal end of the sliding handle and a winch arrangement (9, 47, 51, 92) to retract the sliding handle with respect to the fixed handle thereby to withdraw a sheath (134) from a stent graft (138).

2. An actuation assembly (1) as claimed in claim 1, wherein the winch arrangement (9, 47, 51, 92) includes a ratchet arrangement (46) to allow deployment of the winch arrangement only in a retraction direction.

3. An actuation assembly (1) as claimed in claim 1 or 2, wherein the winch arrangement (9, 47, 51, 92) includes a winch drum (47), a rotation handle (9, 92) for the winch drum and a cable (51) extending from the winch drum to the sliding handle (5, 7).

4. An actuation assembly (1) as claimed in claim 1, 2 or 3, wherein the winch drum (47) is mounted on an axis transverse to the longitudinal extent of the actuation assembly.

5. An actuation assembly (1) as claimed in claim 1, 2 or 3 wherein the winch arrangement (9, 47, 51) comprises a winch drum (47), a rotation handle (9) for the winch drum and a cable (51) extending from the winch drum to the sliding handle (5, 7), the winch drum and rotation handle rotating on a longitudinal axis parallel to or coaxial with the longitudinal extent of the actuation assembly.

6. An actuation assembly (1) as claimed in any preceding claim, wherein the winch drum (47) comprises a tapered body to provide an initial mechanical advantage in use.

7. An actuation assembly (1) as claimed in any preceding claim, wherein the cable (51) is passed around a pulley, protrusion or boss (108) in the sliding handle (5, 7) and returned to the fixed handle (3) to provide a mechanical advantage in use.

8. An actuation assembly (1) a claimed in any preceding claim, wherein the cable (51) includes a band or ribbon of relatively inextensible material.

9. An actuation assembly (1) a claimed in any preceding claim, wherein the actuation assembly includes the fixed handle (3), a release portion (7) and the sliding handle (5) in a telescoping arrangement, the release portion able to slide in a telescoping manner with respect to the fixed handle and the sliding handle able to slide in a telescoping manner with respect to the release portion.

10. An actuation assembly (1) as claimed in claim 9, including a first removable stop pin (60) to prevent movement of the sliding handle (5) with respect to the release portion (7) and a second removable stop pin (62) to prevent movement of the release portion with respect to the fixed handle (3).

11. An actuation assembly (1) as claimed in claim 10, including a third removable stop pin (64) acting between the fixed handle (3) and the release portion (7) to restrict the distance of retraction of the release portion with respect to the fixed handle until the third locking pin is removed.

12. An actuation assembly (1) as claimed in any preceding claim, wherein the fixed handle (3) includes a first grip (15) and the sliding handle includes a second grip.

13. A stent graft introducer actuation assembly (1), the introducer including a pusher (144), a stent graft (133) releasably retained onto the pusher, a sheath (134) coaxially around the pusher and enclosing the stent graft and a sheath hub (130) to which the sheath is mounted, the actuation assembly including a fixed handle (3) and a sliding handle (5, 7), the sliding handle telescoping within the fixed handle, the sheath hub being retained to the sliding handle and the pusher extending from the fixed handle through the sliding handle, and a winch arrangement (9, 47, 51, 92) to retract the sliding handle into the fixed handle thereby to withdraw the sheath (134) from the stent graft (138).

14. An actuation assembly (1) for a stent graft introducer, the introducer including a pusher (144), a stent graft (133) releasably retained onto the pusher, a sheath (134) coaxially around the pusher and enclosing the stent graft and a sheath hub (130) to which the sheath is mounted, the actuation assembly including a fixed handle (3), a release portion (7) and a sliding handle (5), the release portion telescoping within the fixed handle and the sliding handle

telescoping within the release portion, the sheath hub being retained to the sliding handle and the pusher extending from the fixed handle through the sliding handle, a winch arrangement (9, 47, 51) to retract the sliding handle and release portion into the fixed handle to thereby withdraw the sheath from the stent graft, a first removable stop pin (60) to prevent movement of the sliding handle with respect to the release portion and a second removable stop pin (62) to prevent movement of the release portion with respect to the fixed handle, a third removable stop pin (64) acting between the fixed handle and the release portion to restrict the distance of retraction of the release portion into the fixed handle until the third removable stop pin is removed, the winch arrangement including a winch drum (47), rotation handle (9) for the winch drum and a cable (51) extending from the winch drum to and affixed to the sliding handle, the winch drum and rotation handle rotating on a longitudinal axis parallel to or coaxial with the longitudinal extent of the actuation assembly and the cable including a band or ribbon of relatively inextensible material.

15. A stent graft introducer actuation assembly (1) including a fixed handle (3) and a sliding handle (5, 7), the sliding handle telescoping within the fixed handle, a sheath hub (70) being retained to the sliding handle and a pusher (144) extending from the fixed handle through the sliding handle, and a winch arrangement (9, 47, 51, 92) to retract the sliding handle into the fixed handle to thereby withdraw a sheath (134) from a stent graft (138).

16. A stent graft introducer actuation assembly (1) including a fixed handle (3), a release portion (7) and a sliding handle (5), the release portion telescoping within the fixed handle and the sliding handle telescoping within the release portion, a winch arrangement (9, 47, 51) to retract the sliding handle and release portion into the fixed handle, a first removable stop pin (60) to prevent movement of the sliding handle with respect to the release portion and a second removable stop pin (62) to prevent movement of the release portion with respect to the fixed handle, a third removable stop pin (64) acting between the fixed handle and the release portion to restrict the distance of retraction of the release portion into the fixed handle until the third removable stop pin is removed, the winch arrangement

including a winch drum (47), a rotation handle (9) for the winch drum and a cable (51) extending from the winch drum to and affixed to the sliding handle, the winch drum and rotation handle rotating on a longitudinal axis parallel to or coaxial with the longitudinal extent of the actuation assembly and the cable comprising a band or ribbon of relatively inextensible material.

17. A stent graft introducer including a pusher (144), a stent graft (133) releasably retained onto the pusher, a sheath (134) coaxially around the pusher and enclosing the stent graft, a sheath hub (130) to which the sheath is mounted, and an actuation assembly (1) as claimed in any preceding claim.

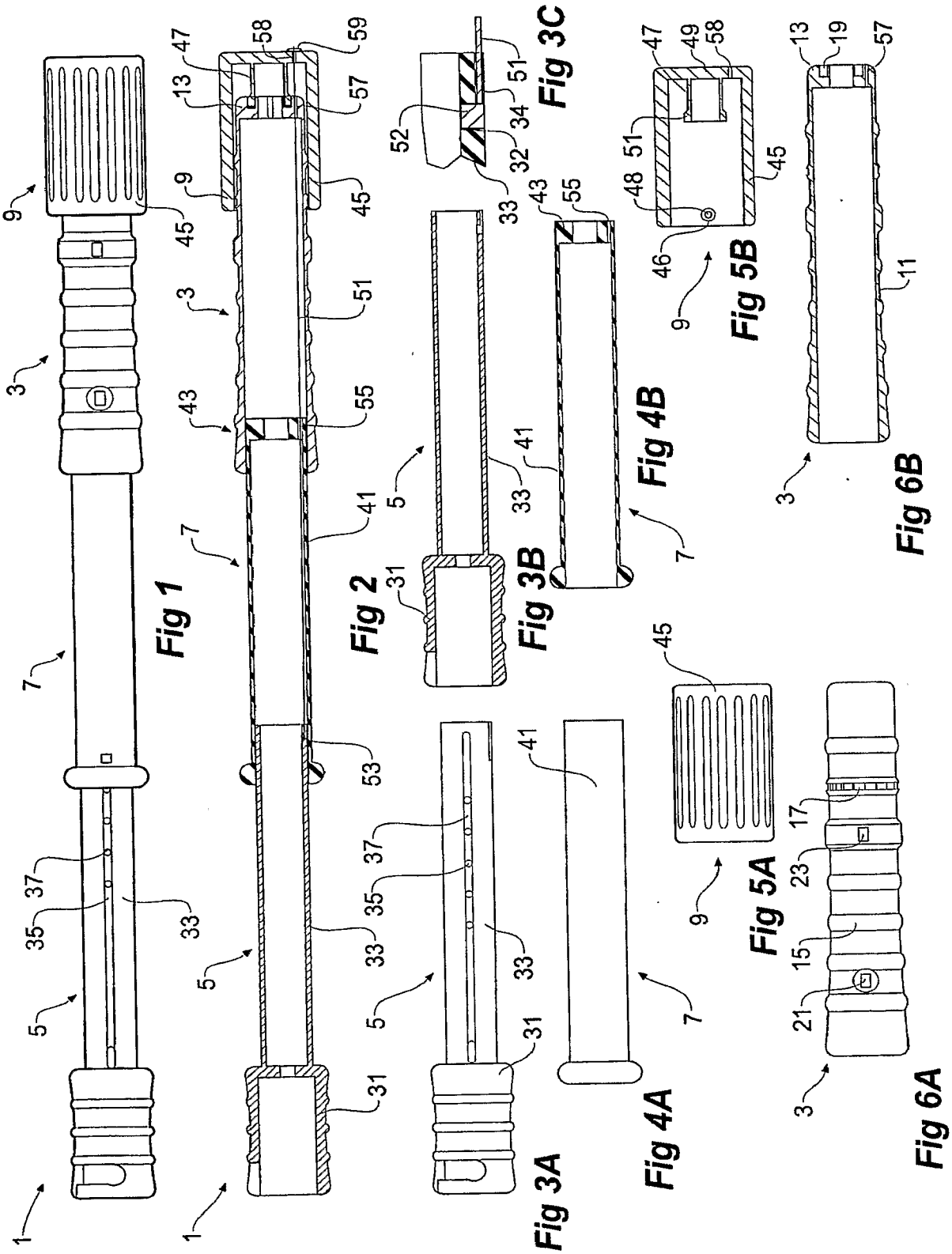
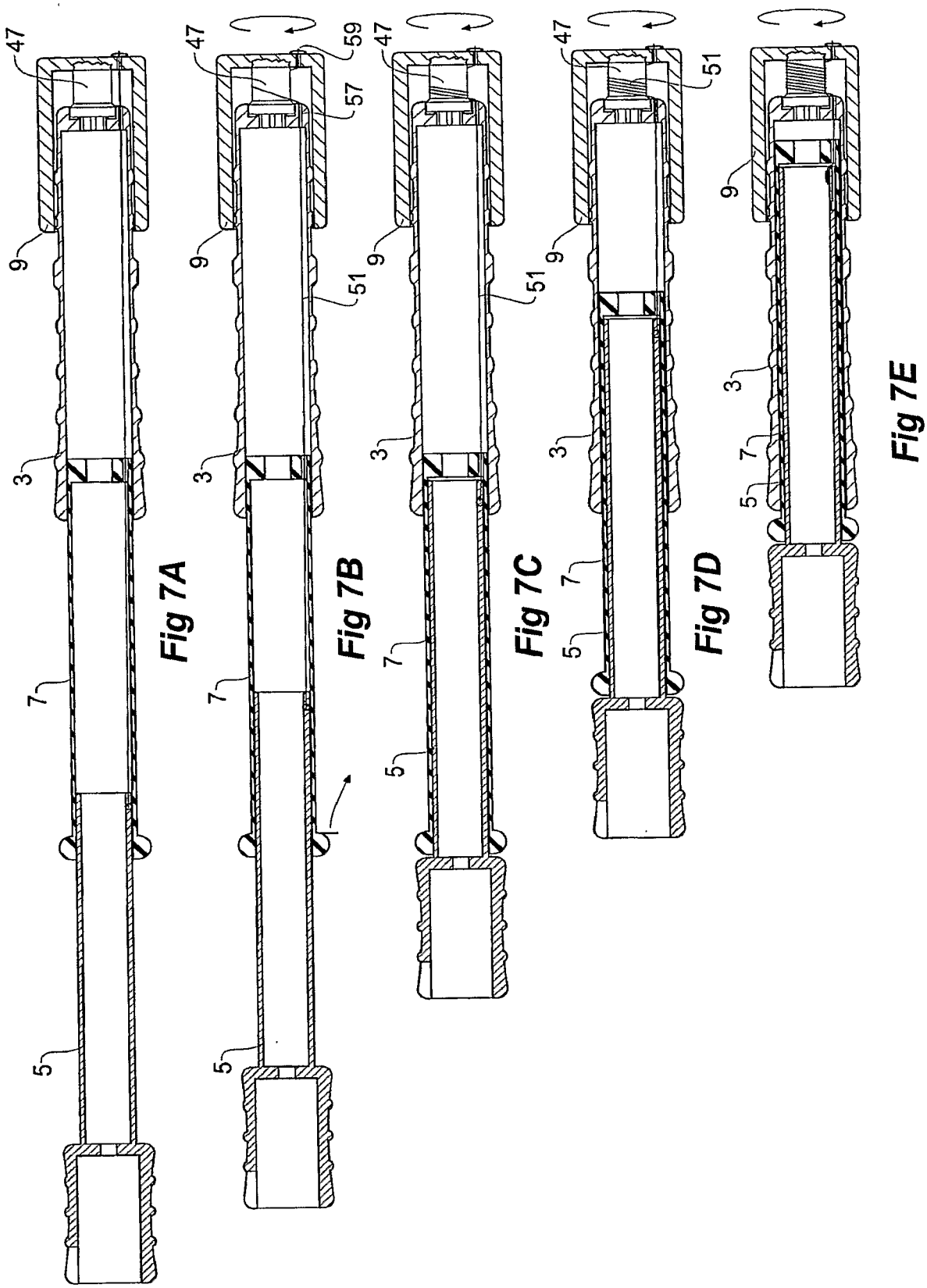


Fig 1
Fig 2
Fig 3A
Fig 3B
Fig 3C
Fig 4A
Fig 4B
Fig 5A
Fig 5B
Fig 6A
Fig 6B


47
9
3
7
5
Fig 7A
47
59
57
9
51
3
7
5
Fig 7B
47
9
51
3
7
5
Fig 7C
47
51
9
3
7
5
Fig 7D
9
3
7
5
Fig 7E

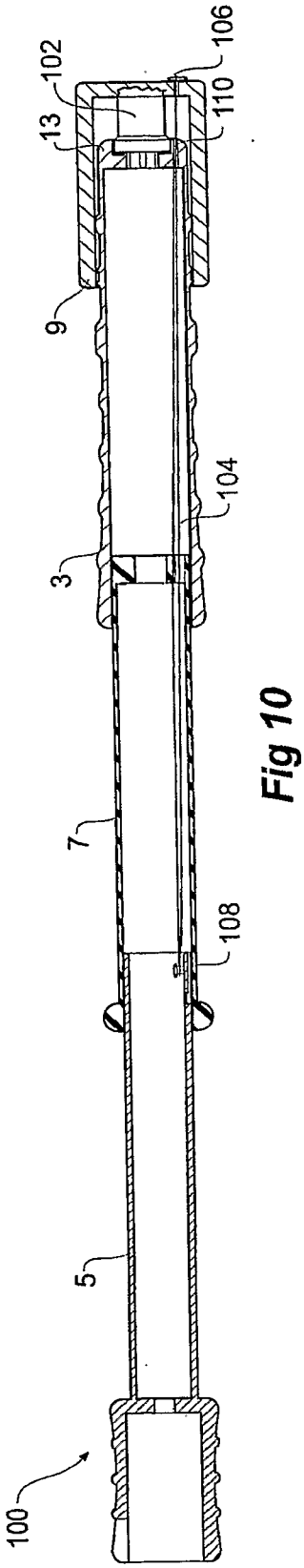


Fig 10

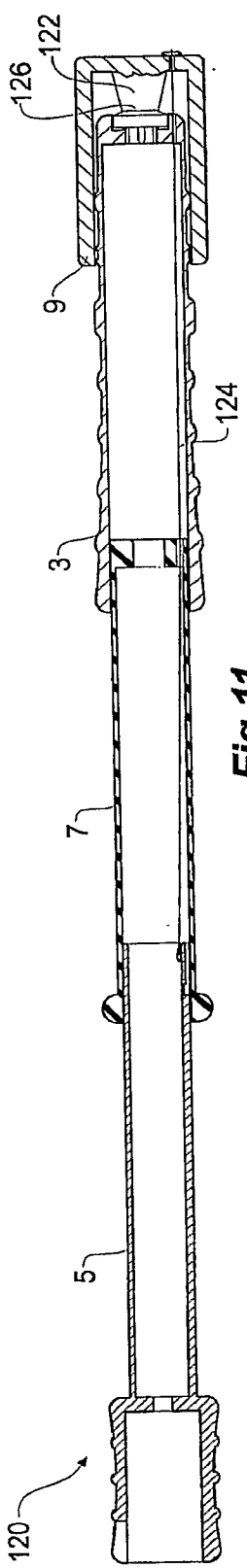


Fig 11

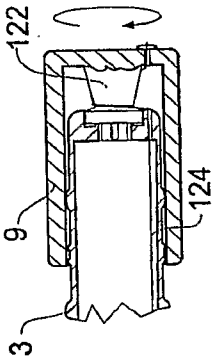


Fig 11A

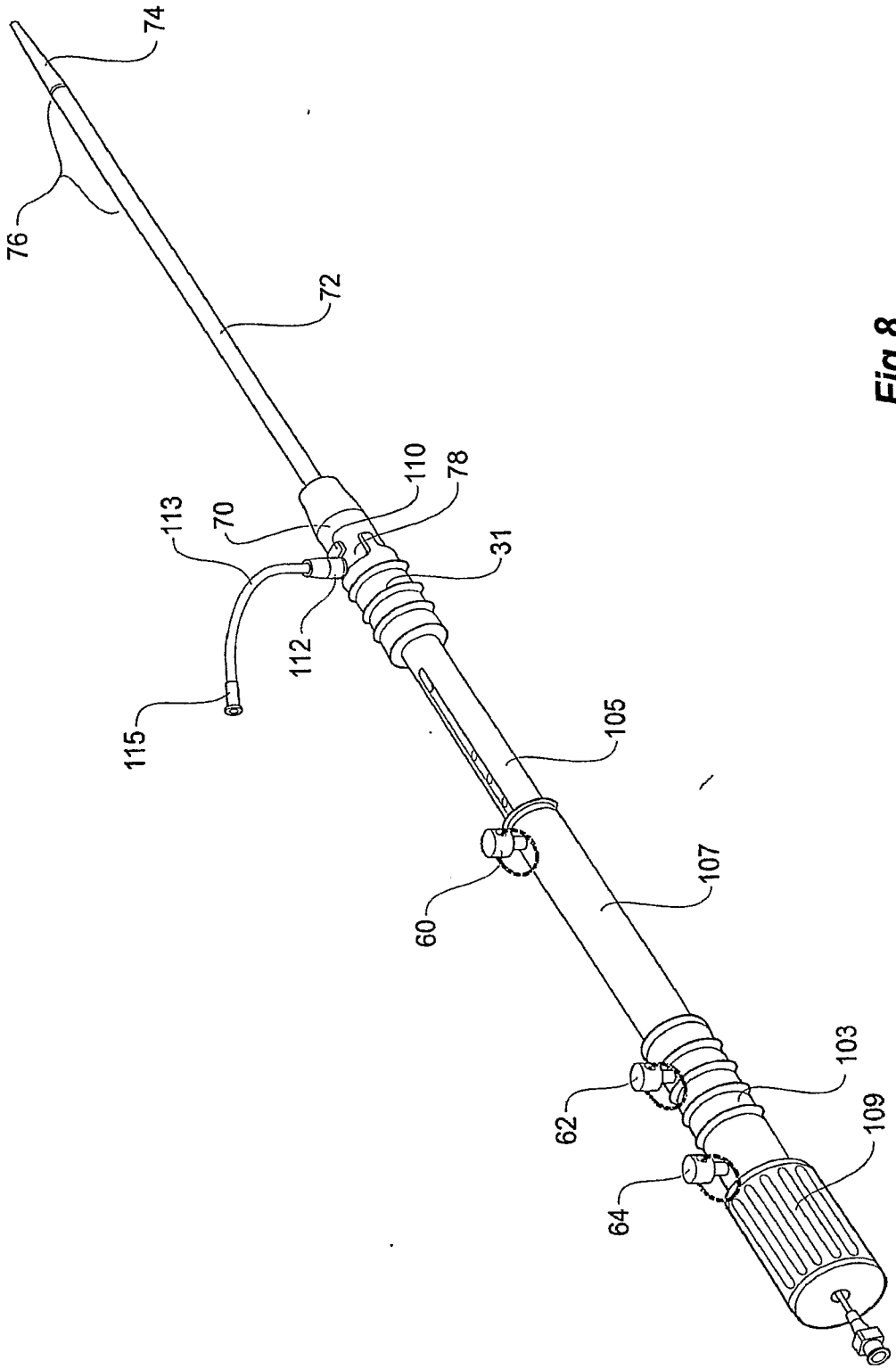


Fig 8

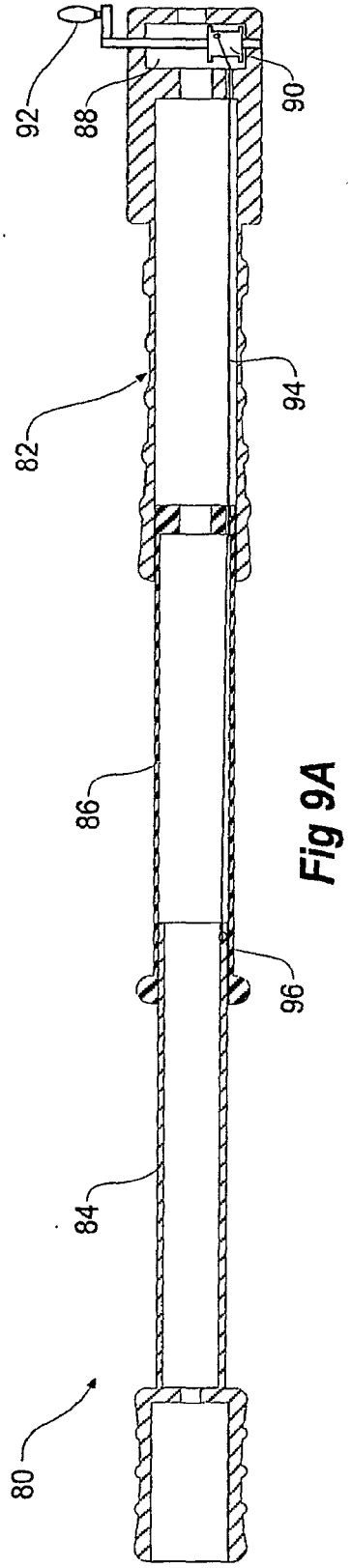


Fig 9A

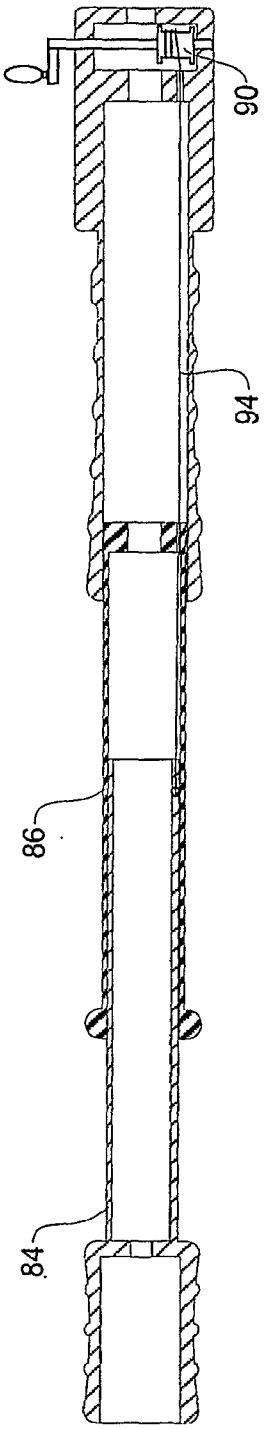


Fig 9B

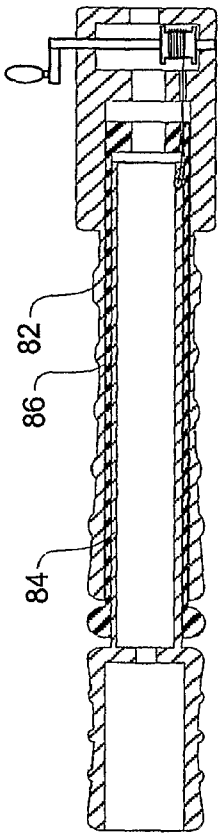


Fig 9C

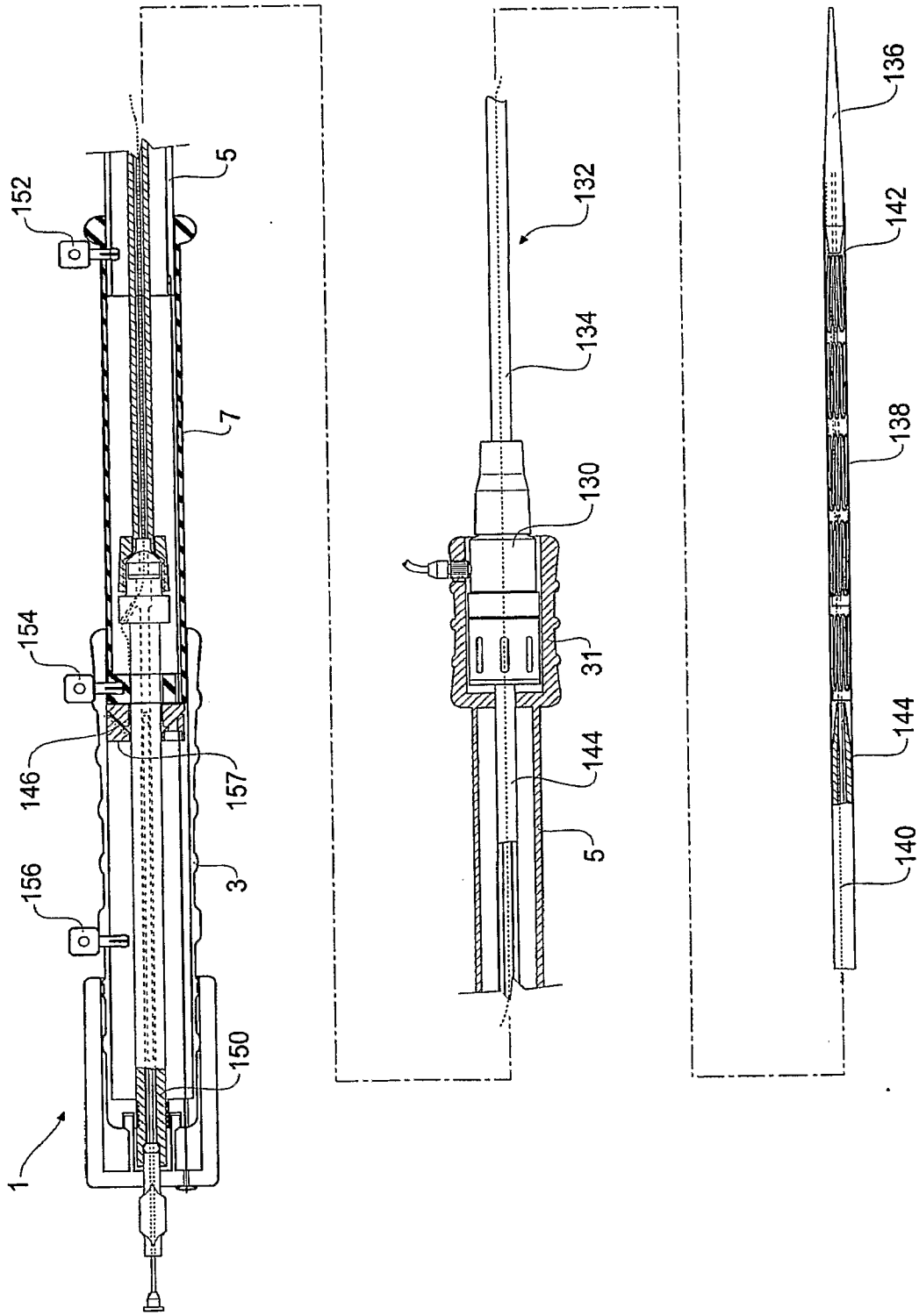

152
5
7
154
146
157
156
3
150
1
132
134
130
31
144
5
136
142
138
144
140

Fig 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/010204

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61F2/84

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)
A61F

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2004/098079 A1 (HARTLEY DAVID ERNEST [AU] ET AL) 20 May 2004 (2004-05-20) paragraph [0042] - paragraph [0051] figures 3,4	1-5,8-17
Y	US 2003/191516 A1 (WELDON JAMES [US] ET AL) 9 October 2003 (2003-10-09) paragraph [0035] - paragraph [0039] figures 2A-2C	1-5,8-17
A	US 5 707 376 A (KAVTELADZE ZAZA A [RU] ET AL) 13 January 1998 (1998-01-13) the whole document	2-5

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

☒ See patent family annex.

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 September 2007	05/10/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Amaro, Henrique

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2007/010204

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004098079 A1	20-05-2004	NONE	
US 2003191516 A1	09-10-2003	AT 347867 T	15-01-2007
		AU 2003225873 A1	20-10-2003
		CA 2478474 A1	16-10-2003
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		JP 2005521514 T	21-07-2005
		WO 03084439 A1	16-10-2003
US 5707376 A	13-01-1998	NONE	