OVER-THE-WIRE INTERLOCK ATTACHMENT/DETACHMENT MECHANISM

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Related U.S. Application Data

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Provisional application No. 60/241,005, filed on Oct. 18, 2000.

ABSTRACT

The over-the-wire interlock attachment/detachment mechanism includes a cylindrical lock receiving section of a small diameter attached to an implantable medical device such as a blood clot filler, a stent, or a septal occluder. This cylindrical lock receiving section has a plurality of spaced, curved cutouts to receive both the guide fingers and contoured locking fingers formed on a cylindrical locking section. The locking fingers are angled outwardly from the cylindrical body of the cylindrical locking section, and are moved inwardly into engagement with the curved cutouts of the cylindrical lock receiving section by a sheath which slides over the cylindrical locking section or other suitable operator.
OVER-THE-WIRE INTERLOCK ATTACHMENT/DETACHMENT MECHANISM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a divisional application of U.S. application Ser. No. 11/200,628 filed Aug. 9, 2005, now pending; which is a divisional application of U.S. application Ser. No. 09/977,971 filed Oct. 17, 2001, now issued as U.S. Pat. No. 6,936,058; which claims the benefit under 35 USC §119 (e) to U.S. Application Ser. No. 60/241,005 filed Oct. 18, 2000, now expired. The disclosure of each of the prior applications is considered part of and is incorporated by reference in the disclosure of this application.

BACKGROUND OF THE INVENTION

[0002] In recent years, a number of medical devices have been designed which are adapted for compression into a small size to facilitate introduction into the heart or a vascular passageway and which are subsequently expandable. These devices, among others, include septal occluders, stents and free standing filters which expand and are held in position by engagement with the wall of an organ or vessel. It has been found to be advantageous to form such devices of a shape memory material having a first, relatively pliable low temperature condition and a second, relatively rigid high-temperature condition. By forming such devices of temperature responsive material, the device in a flexible and reduced stress state may be compressed to fit within the bore of a delivery catheter when exposed to a temperature below a predetermined transition temperature, but at temperatures at or above the transition temperature, the device expands and becomes relatively rigid.

[0003] Originally, these implantable medical devices were intended to permanently remain in place, but recently it has become advantageous to retrieve the previously implanted device.

[0004] The development of removable implantable medical devices such as septal occluders, stents and filters which expand and are held in position by engagement with the wall of an organ or vessel has led to the development of intra vascular snare to retrieve these foreign bodies, usually from the peripheral vessels of the cardiovascular system. Single loop snares, such as those shown by U.S. Pat. No. 3,828,790 to Curtiss et al. and U.S. Pat. No. 5,171,233 to Amplatz et al. are commonly used snare. The Amplatz snare consists of a super-elastic nitinol cable with a single-formed loop. Because of the snare’s super elastic construction, the loop can be introduced through small lumen catheters without risk of deformation. The loop is formed at approximately 90° to a cable, and this allows for the user to advance the loop over a foreign body and ensnare it by closing the loop with a small catheter. The foreign body is removed from the vasculature by withdrawing the device into a guiding catheter or vascular sheath.

[0005] In an attempt to provide a snare with improved cross sectional vessel coverage, multiloop snares such as those shown by U.S. Pat. No. 5,098,440 to Hillstead and U.S. Pat. No. 6,099,534 to Bates have been developed. These snares include loops which are joined only at their proximal ends to a shaft, and otherwise are not joined at any point between the shaft and the distal ends of the loops. This provides the advantage over single loop snares of enhanced cross sectional vessel coverage, and the free distal ends of the loops can be brought together to engage multiple surfaces of an intravascular medical device to be removed.

[0006] The problem with known snare recovery devices is that they are difficult to advance over a medical implant device and require skilled manipulation to retrieve an implanted device. Once the medical implant device is engaged by a recovery snare, there is no assurance that the device will not slip out of the snare during the recovery process.

[0007] It is particularly difficult to remove medical implants from the heart, such as septal occluders, with known snare recovery devices. Such snare recovery devices normally require appropriate sizing to the vasculature in order to facilitate successful ensnarement, and the geometry of multi loop snares is difficult to maintain during delivery. The relative position of the loops can change, both within a catheter or delivery tube and within a vessel, and the loops can actually become displaced or entangled during delivery.

SUMMARY OF THE INVENTION

[0008] A primary object of the present invention is to provide a novel and improved over-the-wire interlock attachment/detachment mechanism adapted to engage and positively lock on to an implanted medical device.

[0009] Another object of the present invention is to provide a novel and improved over-the-wire interlock attachment/detachment mechanism which automatically aligns to form, an interlock attachment with an implanted medical device.

[0010] A further object to the present invention is to provide a novel and improved over-the-wire interlock attachment/detachment mechanism well adapted for use with over-the-wire implanted medical devices.

[0011] Yet another object of the present invention is to provide a novel and improved over-the-wire interlock attachment/detachment mechanism which includes a cylindrical locking section for engagement with a cylindrical lock receiving section connected to the medical implant.

[0012] A further object of the present invention is to provide a novel and improved over-the-wire interlock attachment/detachment mechanism which includes no overlapping components and which maintains a low profile configuration during passage through a vessel and/or catheter.

[0013] These and other objects of the present invention are achieved by providing a cylindrical lock receiving section of a small diameter attached to an implantable medical device such as a blood clot filter, a stent, or a septal occluder. This cylindrical lock receiving section has a plurality of spaced, curved cutouts to receive both the guide fingers and contoured locking fingers formed on a cylindrical locking section. The locking fingers are angled outwardly from the cylindrical body of the cylindrical locking section, and are moved inwardly into engagement with the curved cutouts of the cylindrical lock receiving section by a sheath which slides over the cylindrical locking section, or by another suitable operator which can be activated to move the fingers inwardly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a perspective view of the over-the-wire interlock attachment/detachment mechanism of the present invention with the control sheath shown in section;
DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the over-the-wire interlock attachment/detachment mechanism of the present invention indicated generally at 10 is adapted for movement along a conventional guidewire 12 such as a 0.014" guidewire. The over-the-wire interlock attachment/detachment mechanism includes a male locking section 14, a female lock receiving section 16, and a tubular sheath 18 dimensioned to slide over the male and female sections. Preferably, the female section 16 is secured to an implantable medical device 20 such as a septal occluder; a filter or stent to be released in the heart or a blood vessel or other vessel of the human body or to be retrieved or repositioned within the heart or vessel.

The male locking section 14 includes a tubular body 22 which defines an open ended central chamber 24 through which the guidewire 12 passes. Projecting outwardly from the forward end of the tubular body 22 are one or more elongate guide fingers 26. These guide fingers are straight, elongate pins with acutely shaped ends 28, and two such guide fingers are shown in FIG. 1 although more than two can be provided. The outer surface of each guide finger is preferably coextensive with the outer surface of the tubular body 22.

Also projecting outwardly from the forward end of the tubular body 22 are one or more flexible, elongate locking arms 30 which are substantially equal in width to the width of the guide fingers 26. Underlying each of the locking arms is a slot 32 formed in the tubular body to receive the locking arm. When unconfined, each locking arm is formed to angle outwardly beyond the outer surface of the tubular body 22.

A shaped locking member 34 is formed at the end of each locking arm. Preferably, this locking member, which extends laterally from at least one side of the locking arm, is circular in shape, but other shapes which extend laterally from the locking arm including but not limited to an ellipse, a "T", a rectangle, a square, a hook, a triangle or an "L" can be used. A circular locking member facilitates engagement with the lock receiving section 16. The guide fingers and locking arms are equally spaced around the tubular body 22. They are preferably equal in number, and although two of each are shown, more can be used.

The female lock receiving section 16 includes a tubular body 36 which defines an open ended central chamber 38 for receiving the guidewire 12. The tubular body 36 is substantially equal in diameter to the tubular body 22 so that the two are coextensive when the male locking section is engaged with the female lock receiving section.
and positively engage the male locking section 14 with the female lock receiving section 16.

[0029] Once a positive engagement has been established between the male locking section and female lock receiving section, the over-the-wire interlock attachment/detachment mechanism can be drawn back over the wire 12 to remove the medical implant 20. Because of the positive locking engagement, forces present on the medical implant as it is withdrawn will not result in detachment from the over-the-wire interlock attachment/detachment mechanism. This is very important for medical implants such as the removable filter 54 where hooks 58 must be withdrawn from the wall of the vessel.

[0030] It is often difficult to accurately position a medical implant within a vessel without disconnecting or misaligning the implant relative to the positioning device. This problem is rectified by the over-the-wire interlock attachment/detachment mechanism 10. The medical implant 20 with an attached female lock receiving section 16 is positively locked to the male locking section 14 in the manner shown by FIG. 4 before it is moved over the wire 12 into position within a body vessel. The positive locking action between the male locking section and female lock receiving section facilitates accurate positioning of the medical implant within a vessel without misorientation or the likelihood of a disconnect. Once the implant device is positioned, the sheath 18 can be moved back as shown in FIG. 3 allowing the locking arms 30 to spring outwardly to disengage the locking members 34 from the shaped cutouts 40. Now the male locking section 14 can be drawn back over the wire 12 away from the female lock receiving section 16.

[0031] The sheath 18 may be replaced by other operating mechanisms capable of moving the locking arms 30 into the slots 32. For example, elongate tethers attached to the ends of the locking arms which extend back through the central chamber 24 might perform this function.

[0032] The male locking section 14 can be modified as shown in FIGS. 5 and 6 to provide a flexible end section 68 adjacent to the elongate guide fingers 26 and elongate locking arms 30. By providing a flexible section 68 in the body 22 proximal to the guide fingers and locking arms, it becomes easier to align the guide fingers, locking arms and locking members 34 with the cutouts in the female lock receiving section 16. The flexible section 68 can be formed in a variety of ways. For example, a spring section can be welded or bonded to the body 22 between the main portion of the body and the guide fingers and locking arms to form the flexible section 68. Ideally, as shown in FIG. 5, the body 22 is formed with a unitary spring section 68 by cutting the body in a spiral to create a helical spring 70. This can be done with a laser which can also be used to shape the guide fingers, locking arms and locking members in the tubular body 22.

[0033] Alternatively, as shown in FIG. 6, a flexible, tubular polymer section 72 can be formed between the main portion of the body 22 and the guide fingers and locking arms to provide the flexible section 68.

What is claimed is:

1. A method for retrieving a medical implant comprising: accessing a medical implant using a locking mechanism comprising a locking arm, wherein the locking mechanism is enclosed in a sheath, and the implant comprises a cutout section;
   - sliding the sheath away from the locking mechanism to allow the locking arm to angle outwardly from a longitudinal axis of the locking mechanism;
   - positioning the locking arm over the cutout section of the implant;
   - sliding the sheath back over the locking mechanism to lock the locking arm in the cutout section and thereby locking the implant; and
   - retrieving the locking mechanism with the implant.
2. The method of claim 1 wherein the accessing step comprises accessing the implant with a guidewire and passing the locking mechanism over the guidewire.
3. The method of claim 1 wherein the implant is selected from the group consisting of an occluder, a filter, and a stent.