

[004] Balloon-expandable prosthetic valves typically are preferred for replacing calcified native valves because the catheter balloon can apply sufficient expanding force to anchor the frame of the prosthetic valve to the surrounding calcified tissue. On the other hand, self-expanding prosthetic valves sometimes are preferred for replacing a defective, non-stenotic (non-calcified) native valve, although they also can be used to replace stenotic valves.

[005] Because the catheter must be directed through a patient's vasculature, it typically is beneficial for the operator to be able to precisely control the operation of the catheter, including mechanisms that allow the catheter to be bent to assist in navigating the vasculature, and mechanisms that control deployment of the prosthetic valve.

SUMMARY

[006] In various aspects, the present disclosure provides a clutch mechanism that causes a travelling component to engage an elongated component. A travelling component is a component that moves axially along the elongated component in first and second directions when the elongated component is rotated, respectively, in first or second directions. When the travelling component is engaged with the elongated component, rotation of the elongated component in the first rotational direction causes the travelling component to move axially along the elongated component in a first axial direction. When the travelling component is disengaged from the elongated component, continued rotation of the elongated component in the first rotational direction does not cause further axial movement of the travelling component in the first axial direction. When the elongated component is rotated in the second rotational direction, the clutch mechanism facilitates reengagement of the travelling component with the elongated component such that rotation of the elongated component in first and second directions again results in axial movement of the travelling component in, respectively, first or second axial directions.

[007] Certain embodiments of the present disclosure incorporate a clutch mechanism in a delivery apparatus for a prosthetic heart valve. The delivery apparatus can include an elongated, first component having an engagement portion having threads or grooves and a disengagement portion lacking the threads or grooves. The delivery

from the first elongated shaft can help prevent the travelling component from causing the delivery apparatus to twist, as it might if the torque from the travelling component were transmitted to components at an end of the first elongated component.

[011] In particular implementations, the engagement portion and the disengagement portion are formed on an inner surface of the first elongated component. In some examples, the delivery apparatus includes a pull wire coupled to the travelling component. The pull wire may be further coupled to a distal end portion of a shaft of the delivery apparatus. Axial movement of the travelling component along the first elongated component causes the distal end portion of the shaft to deflect or return to a pre-deflected position, depending on the direction of axial movement.

[012] In another implementation, the engagement portion and the disengagement portion are formed on an outer surface of the first elongated component. The delivery apparatus, in some examples, includes a delivery sheath configured to receive and retain the prosthetic heart valve in a compressed delivery state. The sheath is coupled to the travelling component. Rotation of the first elongated component causes the delivery sheath to advance or retract relative to the prosthetic valve when the travelling component is located on the engagement portion, depending on the direction of rotation.

[013] In another aspect, the disengagement portion is a first disengagement portion located at a first end of the first elongated component and the first elongated component includes a second disengagement portion located at a second end of the first elongated component. In a particular implementation, the biasing member is a first biasing member located at the first end of the first elongated component and the delivery apparatus includes a second biasing member located at the second end of first elongated component.

[014] In other embodiments, the present disclosure provides a method that includes inserting the distal end of an elongated delivery apparatus into the vasculature of a patient. The elongated delivery apparatus can include an elongated component having an engagement portion that includes threads or grooves and a disengagement portion lacking the threads or grooves. The elongated component is rotated in a first rotational direction to move a travelling component axially along the engagement portion of the

We claim:

1. A delivery apparatus for delivering a prosthetic heart valve, comprising:
an elongated, first component comprising an engagement portion having threads or grooves and a disengagement portion lacking the threads or grooves;
a travelling, second component coaxially disposed relative to the first elongated component, the travelling component comprising threads or grooves configured to mate with the threads or grooves of the first elongated component; and
a biasing member located proximate the disengagement portion of the first elongated component;
wherein the first elongated component is configured to be rotatable relative to the traveling component such that rotation of the first elongated component causes the travelling component to move axially along the threads or grooves of the engagement portion, the threads or grooves of the travelling component disengaging from the threads or grooves of the engagement portion upon movement of the travelling component into the disengagement portion the first elongated component, and the biasing member biasing the travelling component against the threads or grooves of the engagement portion such that the travelling component reengages the engagement portion when the rotational direction of the first elongated component is reversed.
2. The delivery apparatus of claim 1, wherein the engagement portion and the disengagement portion are formed on an inner surface of the first elongated component.
3. The delivery apparatus of either of claims 1 and 2, further comprising a pull wire coupled to the travelling component.
4. The delivery apparatus of claim 3, wherein the pull wire is coupled to a distal end portion of a shaft of the delivery apparatus.
5. The delivery apparatus of any of claims 1-4, wherein the biasing member comprises a spring.

6. The delivery apparatus of any of claims 1 and 3-5, wherein the engagement portion and the disengagement portion are formed on an outer surface of the first elongated component.

7. The delivery apparatus of any of claims 1, 2, 5, and 6, further comprising a delivery sheath configured to receive and retain the prosthetic heart valve in a compressed delivery state and coupled to the travelling component, wherein axial movement of the travelling component moves the sheath axially relative to the prosthetic valve.

8. The delivery apparatus of any of claims 1-7, wherein the travelling component is secured against rotation relative to the first elongated component upon rotation of the first elongated component.

9. The delivery apparatus of any of claims 1-7, further comprising a bushing disposed between the biasing member and an end of the first elongated component proximate the disengagement portion.

10. The delivery apparatus of any of claims 1-8, wherein the disengagement portion has a length that is at least as large as a length of a threaded or grooved portion of the travelling component.

11. The delivery apparatus of any of claims 1-10, wherein the disengagement portion has a length that is equal to or greater than the length of the travelling component.

12. The delivery apparatus of any of claims 1-11, wherein the travelling component is a nut, ring, or sheath.

13. The delivery apparatus of any of claims 1 to 12, wherein a proximal end of the first elongated component is operatively connected to a manually rotatable handle portion or a motorized mechanism so as to effect rotation of the first elongated component relative to the travelling component.